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ABSTRACT

The scope of Phase II is the design of a system for document control within the National Agricultural Library (NAL) that will facilitate the processing of the documents selected, ordered, or received; that will avoid backlogs; and that will provide rapid document location reports. The results are set forth as follows: Chapter I, Introduction, establishes a frame of reference for the results of the design study and enumerates the objectives of the future system. Chapter II system Profile, describes the functions of the automated system operations in the order of their operational sequence. Chapter III, Design Background, specifies the broad system requirements and constraints, including design trade-off considerations. Chapter IV, System Design, encompasses the automation of five major functions accomplished in the present manual system and an additional Data Review function, and describes the computer files that contain complete bibliographic information. Chapter V, Implementation, recommends the use of a systems engineering contractor and describes the orientation, training, personnel requirements, and organization for the data-processing group. (Author)

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ED053786

PHASE II REPORT:

DESIGN STUDY FOR AUTOMATED DOCUMENT LOCATION AND CONTROL SYSTEM.

For

U.S. Department of Agriculture
Office of Management Services
Washington, D.C. 20250

December 1968

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BOOZ·ALLEN APPLIED RESEARCH INC.

WASHINGTON
CHICAGO
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December 9, 1968

U. S. Department of Agriculture
Office of Management Services
Washington, D. C. 20250

Attention: Mr. D. F. Peters
Chief, Division of Administrative Services

Subject: Phase II Report, Design Study for Automated Document Location and Control System for the National Agricultural Library—Contract No. 12-03-01-5-20, Amendment No. 4

Gentlemen:

We are pleased to submit this Phase II Report, which completes our two-part system analysis and design study for the National Agricultural Library. Phase I, System Analysis, was completed on August 15, 1967; Phase II, Design Study, was redirected in accordance with Amendment No. 4 to the basic contract and began on February 29, 1968.

The scope of the Phase II system design is in keeping with the mission of NAL to participate in the national network by making agriculturally related material, principally books, serials, and technical reports, widely and conveniently accessible. Our specific Phase II assignment is to design a system for document control within the NAL that will facilitate the processing of the documents selected, ordered, or received; that will avoid backlogs; and that will provide rapid document location reports. The results are set forth in the attached Phase II Report in the following manner:

- Chapter I, Introduction, establishes a frame of reference for the results of the design study and enumerates the objectives of the future system.
- Chapter II, System Profile, describes the functions of the automated system operations in the order of their operational sequence.

- Chapter III, Design Background, specifies the broad system requirements and constraints, including design trade-off considerations. A sequential approach was used, starting with the selection by NAL of a system that would allow real-time processing to the library staff and batch-processing to the outside users. This approach resulted in the development of a set of system components.

- Chapter IV, System Design, encompasses the automation of five major functions (Acquisitions, Serial Record and Control, Cataloging, Circulation Control, and Reference Service) accomplished in the present manual system and an additional Data Review function, and describes the computer files that contain complete bibliographic information (including administrative records for circulation and budget control).

- Chapter V, Implementation, recommends the use of a systems engineering contractor and describes the orientation, training, personnel requirements, and organization for the data-processing group.

We have welcomed the opportunity to serve NAL on this important and challenging assignment. We feel that this report presents an optimal system design, which is vital to the development of the National Agricultural Library.

Should you have any questions, do not hesitate to contact us.

Very truly yours,

C. F. Riley Jr.

BOOZ · ALLEN APPLIED RESEARCH Inc.

C. Frank Riley, Jr.
Vice President

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CHAPTER I

INTRODUCTION

CHAPTER I

INTRODUCTION

The great surge in research that has occurred during the twentieth century has resulted in an extremely rapid growth of man's store of recorded knowledge. This vast buildup of printed materials is not only straining the physical storage facilities of libraries but also generating increased dissatisfaction with traditional library methods for identifying and retrieving information in a collection. Thus, libraries are faced with the challenge of finding a new, responsive, more efficient, and more effective system that not only can meet current needs but also can grow with the user demands of the future.

Three major developments are contributing to change in the traditional mode of operation:

(1) Modernization of current library methods and procedures through the application of technical advances in data-processing, textural storage, and reproduction

(2) Growth, largely under Federal sponsorship, of a national network of libraries and information centers

(3) Extension of the rapidly developing technology of on-line, interactive, time-sharing computers into the library community.

Library systems of the next decade will reflect the confluence of these three developments. Rapid advances in library systems by means of on-line computer systems will greatly extend the scope of library services in the user community, but only if they are supported by the resources of a modernized library and by integration with coordinated networks at the local and national levels.

The transition from the present-day format of library operations to a machine-oriented library system will be evolutionary rather than revolutionary. The rate at which voids in currently available technologies can be filled will dictate the pace of this transition. Thus, it is envisioned that future library systems will progress through several plateaus of development over a period of years.

The course of the applicable technologies, however, is now sufficiently clear to justify the initiation of a major thrust toward the machine-oriented library, which would enable the National Agricultural Library to attain these objectives:

- Maintain and control a comprehensive central resource collection and primary depository of agriculture information that will effectively meet the needs of a national network.

- Administer effective and prompt interlibrary loan service for all participating libraries.
- Provide librarians with a wide range of automated, online, library functions for the purpose of document control and location.
- Increase the quality and scope of library operation by reducing the number of routine clerical tasks.
- Facilitate cooperation with and participation in national and local data-exchange programs.
- Stimulate and increase the interest in and use of library resources and services by providing the agricultural community with convenient and rapid access to documents.
- Keep abreast of and apply latest technological developments as they occur.

The incorporation of these objectives into the design of an automated Document Location and Control System (DLCS), which would become operational by 1973, is the result of a series of trade-off decisions; i.e., balancing the functional requirements against operational constraints and the capabilities of the software and hardware components currently available.

To achieve the objectives of the DLCS and to develop library services for the future, NAL should:

- Establish a single, control organization unit with full responsibility for all data-processing activities and information services.

- Continue developing the recommended computer-based system to allow the user simultaneous and immediate access to the aggregate of all data files pertinent to the collection.
- Initiate a contract for detailed implementation and testing of the recommended system.
- Recruit and reorganize in order to provide technical capabilities demanded for the operation of the system.
- Accept and rigorously follow the implementation plan outlined in this report.

When these actions have been taken, NAL will have a totally integrated command of all the information stored in its collection and will be able to utilize this information to meet both administrative needs and user demands.

CHAPTER II

SYSTEM PROFILE

CHAPTER II

SYSTEM PROFILE

The contractual efforts relating to this study have been directed towards the functional design of an automated Document Location and Control System (DLCS) that would become operational at the National Agricultural Library by 1973. The DLCS is designed to provide long-term solutions for the operational problems of NAL and to project NAL into the emerging national network.

The DLCS is based upon the assumption that NAL will not be a monolithic establishment in which nonautomated methods and procedures constrain the librarian in the creation, maintenance, and location of bibliographic information pertaining to the NAL collection. The DLCS will provide a multiplicity of new information storage and access techniques that will enable the librarian to gain immediate and complete access to bibliographic materials by electronic means.

The heart of the DLCS will be a central computer that will manage the information stored in its memory and will be time-shared by the user community. The librarian and staff will have access to all the stored information for the collection via remote terminals. These terminals will be of two principal types:

- A cathode-ray tube (CRT) terminal (a television type of medium) that will provide a visual display of any data in the bibliographic record
- A typewriter that will be used to enter query statements to create, update, or delete any data element in the file, and to provide hard copy of bibliographic information displayed on the CRT terminal.

The library staff will have three processing capabilities via these terminals:

- To create: To enter or initiate new bibliographic record in a particular file
- To maintain: To add, update, or delete elements of data on an already existing record
- To query: To enter statements for access to any file in the library for location purposes only.

The latter of these capabilities is the most critical to the system's operation because some form of file query is employed in practically all of the automated library functions.

Query techniques affect the amount of storage required in the configuration, the cost in machine time of querying the data base, the cost in machine time of creating and adding to the data base, and the cost of developing programs to perform these functions. The selection of the optimum organization for the data base and the associated query techniques has been based upon a detailed study of operational and system trade-offs.

The system, in essence, is the files. These files are indexed by four data elements that are direct-access points, namely, author, title, accession number, and subject terms/descriptors. These data elements are the only direct-access points for entry into the bibliographic record file, which contains a record for each item in the NAL collection controlled by the DLCS. All other data elements are available in each bibliographic record and can be obtained through sequential machine search or complete visual display of the bibliographic record on the CRT terminal.

A data record may be in one of these three conditions or locations:

(1) When the data are complete and verified, they are called part of the permanent data base. These data are universally available for readout but are subject to carefully controlled limitations on alteration.

(2) Data that are incomplete and that have not yet passed a final verification are said to be part of the intermediate data base. The distinction is primarily philosophical since a query will take data from both, when necessary.

(3) A third type of data, however, is different in an essential sense; these are called working data and are available only at the individual remote terminal. They are available only to the user of that terminal and, until a transfer action is initiated, are easily changed.

Thus, at any point in time, each file or index is actually made up of data in three various states. The intermediate and permanent states constitute the data used by the system as a whole; the working data is the "scratch pad" of the user at a particular terminal (e.g., a staff member creating or modifying the data base).

Figure 1 represents the system flow as it will occur after final implementation. The system design is based upon five library functions and one data-review function.

The process flow of items begins in the selection activity of the acquisition function. Selection consists of scanning the bibliographies, unsolicited items, blanket order items, publisher's catalogs, etc., to determine additions to the collection that follow the guidelines of the scope manual. The current holdings of the library must be scanned to avoid unintentional duplication and unnecessary additions to the collections. In addition, the group performing this function will initiate the bibliographic record by performing the descriptive cataloging for each item.

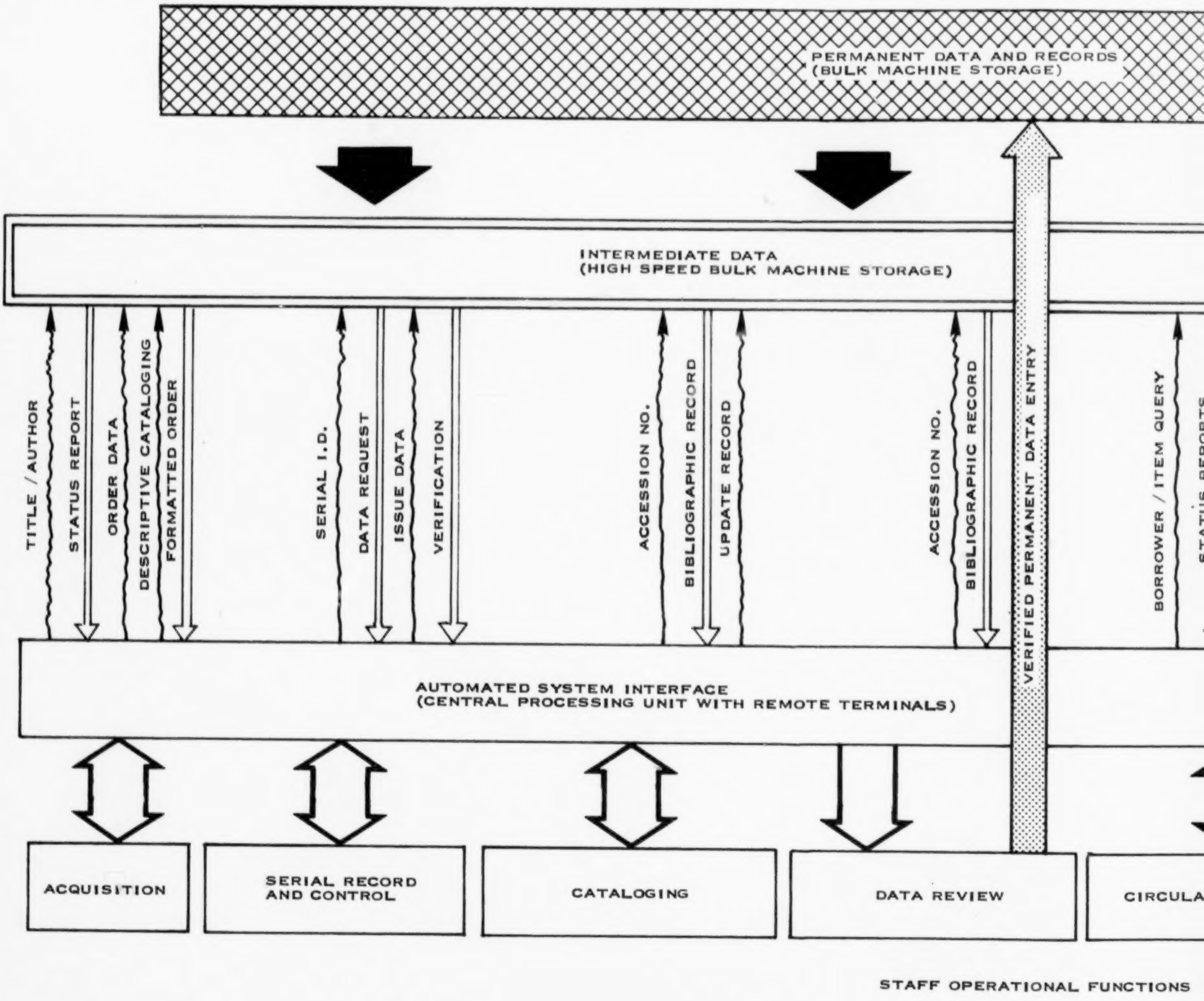
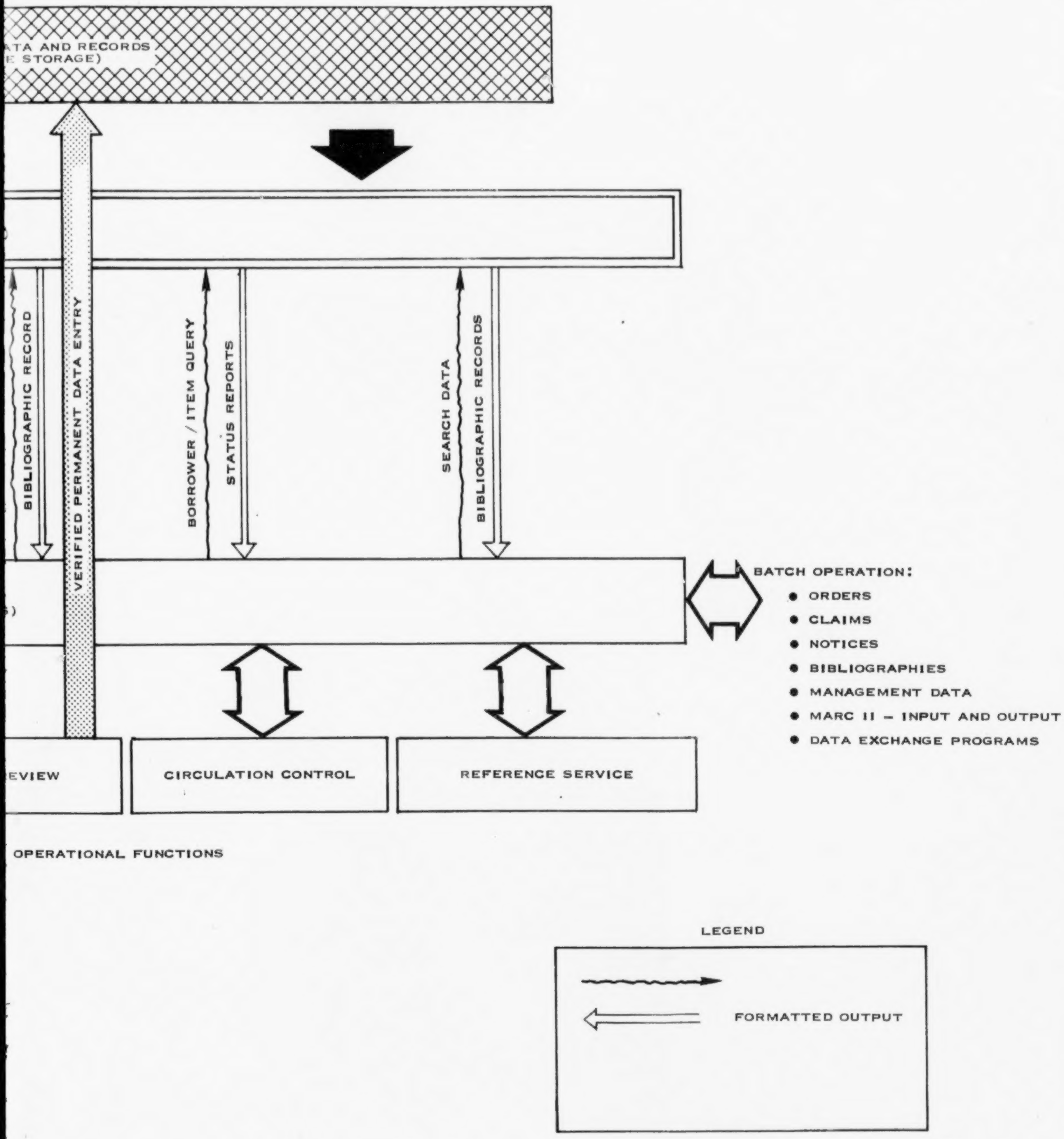

PERMANENT DATA AND RECORDS
(BULK MACHINE STORAGE)
INTERMEDIATE DATA
(HIGH SPEED BULK MACHINE STORAGE)
TITLE / AUTHOR
STATUS REPORT
ORDER DATA
DESCRIPTIVE CATALOGING
FORMATTED ORDER
SERIAL I.D.
DATA REQUEST
ISSUE DATA
VERIFICATION
ACCESSION NO.
BIBLIOGRAPHIC RECORD
UPDATE RECORD
ACCESSION NO.
BIBLIOGRAPHIC RECORD
VERIFIED PERMANENT DATA ENTRY
BORROWER / ITEM QUERY
AUTOMATED SYSTEM INTERFACE
(CENTRAL PROCESSING UNIT WITH REMOTE TERMINALS)
ACQUISITION
SERIAL RECORD
AND CONTROL
CATALOGING
DATA REVIEW
STAFF OPERATIONAL FUNCTIONS

FIGURE 1
NAL Automated DLCS
Interfaces


ATA AND RECORDS
E STORAGE)
BIBLIOGRAPHIC RECORD
VERIFIED PERMANENT DATA ENTRY
BORROWER / ITEM QUERY
STATUS REPORTS
SEARCH DATA
BIBLIOGRAPHIC RECORDS
)
BATCH OPERATION:
● ORDERS
● CLAIMS
● NOTICES
● BIBLIOGRAPHIES
● MANAGEMENT DATA
● MARC II – INPUT AND OUTPUT
● DATA EXCHANGE PROGRAMS
EVIEW
CIRCULATION CONTROL
REFERENCE SERVICE
OPERATIONAL FUNCTIONS
LEGEND
FORMATTED OUTPUT

When the decision has been made on the desirability of an item (within the scope) for the collection (a bibliography, citation, gift, etc.), the librarian can query the data base via the CRT/typewriter terminal. The query would be one of the four data elements used for direct access, the most common being author or title. If no item is found to satisfy the query, a message is visually displayed indicating that the item is not in the collection (the permanent data base) nor on order nor in the process of being added to the collection (the intermediate data base). If an item is found in the file, the complete bibliographic citation will be displayed. If the item is found to be on order, the purchase order number, date, number of copies ordered, and current status or location are displayed.

If an item is not found in the collection and a decision to order is made, the librarian enters the author and title; and the system automatically generates an order number for the item. This order number is used to control the information entered in the system for the item until the accession number is assigned (when the item has been received). The documentation relating to the item is passed to those engaged in descriptive cataloging for entry into storage of all data available at this time.

Items chosen for the library collection, either to be ordered or received as a gift or exchange, will have as much as possible of their descriptive cataloging completed by this group. The senior librarian who makes the selection will route all documentation on an item, or the item itself, to technicians who will enter all cataloging data available before the material is forwarded to the acquisition group for processing.

Other activities included in the acquisition function are: ordering, monograph claiming, receiving ordered items and their associated invoices, giving approval for payment, maintaining account-payable data, and assigning accession numbers to items added to the collection.

The acquisition clerk can key in the order number to obtain a display of information so that he can compare the data cataloged during the selection process with the correspondence in hand. After verifying the two sets of information, he enters, via the CRT terminal, the vendor/publisher code, the account to be charged, the estimated price, etc. These data complete the information entered during selection.

All orders entered during a particular day are consolidated and processed for printing of the orders.

When requested items are received, a similar procedure is used to have a record displayed for check-in purposes. When an item is added to the collection, an accession number is automatically assigned; and a label is printed.

The acquisition clerk orders new serial titles the same as non-serials with the exception of the inclusion of additional data elements that are not required for non-serials. For example, he indicates if this order is for a single copy to be included in the library holdings, for a new subscription, or to reopen a closed entry, etc. The system provides for original entry of items that are not to be currently ordered, because of lack of funds or some other reason, but are to be ordered in the future. The acquisition clerk can enter the data available on the item and have it recalled periodically, on demand, for review. The system provides a visual display of back-orders on a regular basis if no transactions (other than the new entry) have occurred on the list over a fixed period of time.

The serial record and control function in the recommended system design involves the use of a permanent, laminated, machine-readable title card. This card makes possible a graphic presentation of the specific serial title and its pertinent data elements.

Upon receipt of a serial item, the checker matches the incoming item with the title card. The serials clerk inserts the card into a transactor terminal, and the system indicates what information must be inputted for that particular item (issue number, date, volume number, etc.). When the clerk enters the required data through the terminal keyboard, the system responds by automatically printing an accession label for the item. The checker attaches the label to the item and sends it to its destination, which has been noted on the label automatically by the system. The destination is coded to indicate such areas as stacks, Bibliography of Agriculture, circulation, etc. The information entered on the initial purchase order for the serial and notification of receipt of the first issue of that order is enough data for the program to generate both a record and a renewal reminder list, which will be perpetuated from year to year so long as the library maintains the serial as an open entry.

The cataloging function is the last area of technical processing for a new item before it is available for use. Because the basic purpose of cataloging is to establish the relation of each new acquisition to similar holdings in the collection (and thus its relation to the collection) and to facilitate user access on a topical basis, it is important that a logical continuity with existing cataloging practices be maintained. Thus, the existing practices of descriptive and subject cataloging are perpetuated, and the acquisition is uniquely identified. The catalog query is straightforward and is handled in the same manner as queries of the data base for other functions of the system. The only difference is the use of formats for transmission. Book catalog production is handled in essentially the same manner as is production of the current book catalog except that it will be derived, automatically, from the data base.

To perform the data-review function, the final review checker will call up the entire record (via the accession number) from the intermediate data base and review it for completeness, correctness, and conformance with NAL practices. When the record is accurate and complete, he instructs the system (via a CRT/typewriter) to transfer the record to the permanent file and to update all effective records. This is the only major review. It eliminates the costly correction of errors that might otherwise slip unnoticed into the system. Item records transferred to the permanent data base are flagged for subsequent batch processing for production of requisite hard-copy outputs or various marked-tape outputs.

The circulation control and reference service functions communicate information about the collection to the library users. The circulation and reference activities include interlibrary loan, on-site reader service, and factual and bibliographic responses to user requests. Staff personnel in these groups will have access, for search purposes only, to all files in the system regardless of item status (i.e., on order, in process, or on the shelf). The current location of an item is the only data element they have the capacity to update. For example, if an item is removed from the shelf for use in the reading room, the clerk will be able to update the current location (via a keyboard terminal) to indicate that the physical item is actually in the reading room.

The reference librarian can search the entire holdings or records of the library, by using author, title, subject or accession number, for a display of items available to satisfy the request and their current locations (shelf, bindings, etc.). He can also request a printout of the display, if necessary.

Upon receipt of a loan request either from an on-site reader or by mail or telephone, NAL personnel can search the bibliographic data base by entering the query criteria (e.g., author, title, accession number) to determine the holdings information. After the terminal displays the author, title, accession number, current location shelf location, etc., of the item or items that satisfy the request, the system requests the borrower's name and address. When these are keyed in, the system automatically prints out a mailing label.

The computer is the ideal machine for keeping and generating statistics acquired from the various functions. Gathering these statistics entails no additional effort on the part of the library staff because the data generated are by-products of the various processing activities. Emphasis throughout the design has been placed on those elements necessary to productivity statistics so that cost information and workload factors can be available on demand. All information that might be of use to management in future planning and decision-making can be retrieved from the system quickly, accurately, and economically.

CHAPTER III

DESIGN BACKGROUND

CHAPTER III

DESIGN BACKGROUND

This chapter discusses the requirements and constraints on the system design and the effectiveness trade-offs. Included are the generalized system operational concepts supported by the alternative hardware and software components that are considered candidates for the operational system. The information presented provides NAL with the necessary rationale for the system description presented in Chapter IV.

The Phase II design approach is based upon the elimination of the alternatives at successively finer levels of detail. The alternate gross system operations and components are analyzed in this chapter, and, on a "best fit basis," a particular alternative has been chosen. A recommended design approach that is a logical outgrowth of this trade-off analysis is presented in Chapter IV.

1. SYSTEM DESIGN REQUIREMENTS AND CONSTRAINTS

NAL has directed(1) that the system fulfill the following requirements:

- Be in keeping with the mission of NAL to participate in the national network.
- Facilitate processing of the documents selected, ordered, and received; avoid backlog; and provide rapid document location reports.
- Accomplish routine portions of document control functions with automatic data-processing.
- Accept general bibliographic descriptions in the Library of Congress MARC II format.
- Accept the character set specified by the National Libraries Task Force on Automation and Other Cooperative Services (NLTF).
- Accept bibliographic descriptions for monographs that will conform with respect to the number and definition of the elements of the MARC II standard.
- Accept, insofar as is presently definable, serial bibliographic descriptions that conform to the standards of the National Serials Data Program of the NLTF.
- Accept bibliographic descriptions of technical documents i the form of COSATI standards except where these conflict with MARC II, which shall have precedence over COSATI.
- Store personal name, corporate name, subject heading, and report number authorities.
- Store records of transactions to indicate flow, current status, and location of documents, including procurement, disposition action, vendor performance, and chargeout and circulation records.
- Accept updates to existing files from information generated at NAL or received in MARC II format.
- Provide primary access to the stored data files by title, author, subject, or identification number.

- Provide secondary access to the files by any other structured element of the bibliographic descriptions.

- Safeguard the files against inadvertent or unauthorized inclusion of erroneous or ambiguous data and against deletion of existing data.

- Provide 100,000 document location reports a year with a maximum response time of 2 to 10 minutes.

- Output bibliographic records in the MARC II format.

- Output administrative documents, including orders, claim notices, and binding orders.

- Output statistical and fiscal reports to permit NAL to make future plans based upon definitive data.

- Facilitate interfaces with Chemical Abstracts, Biological Abstracts, the Library of Congress, and the National Library of Medicine.

To develop a unified Document Location and Control System (DLCS) that will meet present needs, will create a foundation for automation, and will project NAL more broadly into its national role, BAARINC has translated these broad requirements into specific performance characteristics. Thus, the NAL automated system must perform in the following ways:

- Provide a minimum processing capability for handling the more than 4,900 daily transactions of the current workload with allowances for a growth of approximately 60 percent in 5 years.

- Possess an ultimate storage volume capability in excess of 400 million characters so structured that it does not exceed an average cost of 0.05-cent per character.
- Offer improved staff efficiency and accuracy through the use of remote terminals for real-time communications with a common data base containing all major files.
- Be a multipurpose system for a variety of users with ample allowance for functional growth.
- Be based upon hardware and software modularity to provide minimum cost to update and maximum capability to expand.
- Make complete use of third-generation hardware and software to take advantage of new information handling and storage techniques, including multiprocessing, simultaneous multiaccess remote input/output, background batch processing, and cheap bulk storage.

The above requirements and constraints dictate the following four broad operational characteristics:

(1) Acquiring and controlling items for the collection

(2) Cataloging and classifying all items in the collection

(3) Answering specific questions based upon material in the collection

(4) Controlling the physical location of each item.

These broad characteristics form the basis for the alternate operational concepts, which are presented in this chapter.

2. SYSTEM DESIGN TRADE-OFF CONSIDERATIONS—OPERATIONAL

Any system as large as NAL requires an operating philosophy of division by functional area; however, the functional areas that have been defined and adhered to in the manual system environment will require change to utilize the automated system effectively. The availability of central multiple-access files permits consolidation and elimination of many subtasks of the broader functions.

There are five functions basic to a Document Location and Control System for NAL: acquisition of documents, recording and control of serials, cataloging of each item, recording and control of document circulation, and reference services. The effects of the automated system on these functions and the consideration of system configuration alternatives to perform these functions are presented in the following sections.

(1) Acquisition Function

It is desirable to make known to the user not only what is in the collection but also what is on order or in process and approximately when it will be available to him. Delays in communication can be kept to a minimum if data on an item are inputted as soon as possible. The effort required to do this during the selection activity in the acquisition function is offset by the advantages of automatically generating the physical order and automatic monitoring of the status of the order. As a result of this early input of data, one-third of the monographs to be checked in will require only a verification and correction of the existing data base entries inputted when the item was selected.

Automated systems will not materially aid the actual selection, which is essentially an intellectual process. When publishers and other sources of new material make bibliographic data available in machine-readable form, it will be possible for the automated system to be a more effective tool for the selector.

Cataloging causes the longest delay in getting new items to the shelf and ultimately to the user. For this reason, and because expansion of the cataloging staff is both expensive and difficult to implement, it is advisable to put as much descriptive information as possible in the data base before the final classifying step, thus reducing the routine operations to be performed when the item is actually received. Much of the information noted at selection (e.g., title, author, publisher, date, etc.) can be inputted to the system immediately. When such descriptive cataloging is done at this point in time, a substantial part of the routine effort in the cataloging function is eliminated.

A variety of techniques are available for automatically producing a machine-readable identifier for each item; i.e., punched cards, magnetic ink cards, or labels suitable for an optical character reader (OCR). Punch cards are inexpensive (costing about 6 cents per card to produce) and could be generated remotely, but cards are also easy to damage or lose. Magnetic cards offer the advantage of direct readability but are more expensive to produce and also are easy to damage or lose. Since some external identification must be placed on each item to allow rapid retrieval from the shelf, the most efficient method would be to combine the accession number label and the machine-readable feature. A self-adhering label formatted for optical scanning could be produced and attached to the document at the time of acquisition. Although the capability to read optically and to convert the label into electronic form is within the current state-of-the-art, the equipment capability to support the NAL system is not yet available. Consequently, punched cards, rather than the more expensive magnetic cards, have been selected as the best alternative for document identification in the initial system.

The general capability of ready access to all files will be a direct aid to many tasks necessary to the acquisition function. A need for remote terminals with full conversational capability with the machine-readable data base is justified by the current frequency (estimated at a minimum of 120,000 file lookups per year) with which these files are consulted.

(2) Serial Record and Control Function

Issues of each serial title cataloged and established as one to be retained must be identified, and the appropriate data must be entered into the data base. Any processing scheme for incoming serials contains at least four logical steps:

1. Sorting
2. Identification
3. Data Entry and Verification
4. Routing and Accessioning.

In addition to these basic processing steps, other characteristics must be considered in a serial processing system;

e.g., size, handling of exceptions, and renewal orders. The following sections present the significant factors in these areas that affect system design.

1. Sorting

Sorting is basically a form of preliminary identification; it may overlap somewhat the identification step. Its sole purpose is to allow division of labor into more specialized categories to improve the efficiency of the identification process. Two levels of sorting can be beneficial:

- Presorting by mailing address
- Sorting into several special divisions of the serial collection.

If an effort is made to have the sources of serials use coded addresses, presorting will simplify the process of separating the expected serial issues from other items. Such a system is not foolproof because many sources may use the same mailing label for ordered items as for unordered items such as new titles, advertisements, or announcements. The more unordered items, however, that are removed from the chain of routine processing at an early point, the less the effort expended on them.

Because the volume precludes one station or person checking-in all serials, a number of work stations for this function must be assigned. It would be possible to divide all serials randomly and to allow each station to process any serial. This method is simple but does not take advantage of the ability of a checker to become more familiar with each title of a smaller subset of the total serial collection; it also requires duplication of all title cards. Division of labor is standard practice in any production operation, and serial check-in is the one area at NAL most responsive to production orientation. Even though many items may not fit neatly into routine procedures, the vast majority will, thereby justifying a breakdown of the serial population in the more restrictive categories. The first sorting will be into two broad categories:

- Roman alphabet (any language)
- Non-Roman (including nonalphabetic).

It will also be helpful to segregate for special action the large quantities of gifts that arrive.

From the study of languages made during this contract (see Appendix A), in 1958 these categories contained essentially:

Roman	97%
Cyrillic	<3%
Other alphabets and nonalphabetic	<1%

Even if the last two categories are doubled to allow for increases since 1958, and if the processing time allowed per item is also doubled, the quantities represented by these two categories are still within the workload of one checker. Thus, the final sort will divide the Roman alphabet into 13 categories based upon an equal volume, and the remaining category will go to category 14.

The question might also be raised as to the value of sorting out certain languages within the Roman characters for processing by a checker with special language skills. Unfortunately, there are only two languages that amount to as much as 5 percent of the total volume; this is not enough to occupy a checker full time. Thus, two or more languages would have to comprise the workload of one checker.

A smaller portion of the English alphabet would be a better scheme because people with skill in two or more foreign languages would be difficult to obtain at a grade consistent with routine processing. On the other hand, the possibility of finding people with one language skill plus a moderate facility with English in the Metropolitan Washington area is high. Therefore, it might be possible to have the more common languages—German, French, and Spanish—processed by checkers skilled in the language; however, this would mean a problem of more sophisticated sorting would be introduced into the system. If the sorter did not have at least rudimentary skill in several foreign languages, it would be necessary for the checkers to perform a third-level sort or to replace the second-level sort completely. Past experience indicates that checkers can be trained to handle serials printed in Roman alphabets without knowledge of the language but the added restraints on personnel and procedures that such a system entails does not seem warranted. This is especially true because professionals assigned to serial control as special checkers are likely to have language skills.

In very unusual cases, such as Oriental serials, it may be desirable to obtain people with special skills on an "as needed" basis. Past NAL experience indicates, however, that one person with limited training could handle all non-Roman serials if the time allowed per issue is two to four times that allowed for the Roman serials.

2. Identification

The process of correctly identifying each serial item is the most difficult intellectual task required of serial check-in. Consequently, any aid the system can provide to the checker should receive highest consideration. A large number of techniques have been considered by various libraries. They run the gamut from a scheme with no prepared input (key in the entire title and other pertinent information) to a scheme using a prepunched card that fully anticipates the item (all the pertinent data is on the card, which is inputted when the item is received).(2) Both schemes have shortcomings when applied to the enormous quantity of issues (approximately 375,000) that must be processed in NAL.

Some intermediate or hybrid alternative must be used. Hopefully, the process will have pertinent advantages of both extremes. The prime advantage of the first method is that no prior knowledge of the arrival of the particular item is required. This allows considerable flexibility for irregular and unexpected items; however, the labor involved in inputting the amount of data that would be necessary at NAL would more than offset the small gains. The second method avoids this problem but loses the advantage of flexibility. In actual practice, it has been extremely difficult to predict accurately for large serial collections what items can be expected during a particular time period.

The ideal system would minimize the amount of input necessary to the computer while maintaining flexibility of the input. A single, permanent card for each title currently received by NAL fulfills this ideal. This card, being machine-readable, would be matched against the incoming item and inputted to the computer to identify the serial being processed. The card would be used many times, thereby justifying the investment in a permanent card that would include explanatory notes and, for especially difficult items, graphic or photographic aids. In many cases, a simple match between the pictorial title card and the actual serial item could be accomplished rapidly. Thus, input flexibility is maintained while minimizing the necessity for manual inputting. In cases where an item is to be discarded but for uncorrectable reasons is still received, a card (i. e., guide card) identifying the item with directions for its disposition is included with the other title cards.

3. Data Entry and Verification

Although identification is the most difficult processing step, improper entry of data will give rise to the largest number of errors. In the system envisioned, the machine-readable card would be inserted into a device for reading the card into the computer. Then the automated system could respond with pertinent information about the serial title from the bulk data storage. This system response would be in the form of a request for the specific information required to update serial holdings. This data, manually keyed-in to the system by the checker, would be analyzed by the computer for reasonableness.

Such a test would generally be based upon consistency with previous data with modest allowance for issues received out of order. For example, if a particular serial was currently in the middle of volume 12 and issue 15 had been received, the system could be designed to accept issues 6, 7 and possibly 8 in any order. If, however, the checker inputted volume 25, it is obvious that the serial has been misidentified, or the wrong information has been read from the serial, or the information has been erroneously keyed. In this simple manner, both the accuracy of the identification step and the accuracy of the data inputted can be verified.

A variety of hardware is currently available for accepting various, permanent, machine-readable cards in addition to manual inputs in alphabetical or numerical form. System queries for specific data can be indicated by a lighted panel with the description of the data desired. Although such a system necessarily limits the range of queries that can be expressed by the system, it is considerably more economical than either a cathode-ray tube (CRT) readout or a hard copy printout.

The problem posed by foreign language journals, where the word "volume" or "number" would not appear in English, can be handled in the form of notes and directions on the permanent plastic card, thereby eliminating the necessity of outputting the foreign words. In fact, this is an improvement over the present system, which depends upon the checker's knowledge for identification of the appropriate data elements.

4. Routing and Accession

Each serial item must be permanently identified for future handling, and its immediate disposition on leaving the serial check-in system must be determined to complete the processing of the serial check-in function. To eliminate manual creation of such records, a hard-copy device should be included at each serial check-in station to provide a self-adhering label with both the accession number for the item and internal routine instructions (e.g., to circulation, stacks, B of A, etc.). External routing (e.g., to an individual) is handled by the circulation function. The alternatives to this method have already been discussed with respect to new acquisitions.

5. Sizing of the Check-In Subsystem

The two factors that determine the number of check-in stations required are the number of items expected and the length of time required to process each item. The number of serial issues added to the collection in 1967 was 258,337. The gross number received was 575,333. (The difference is due to many factors, including gifts not kept, items kept for a fixed period and discarded, and backlog in specific areas.) Because most of these items would eventually be handled by serial check-in and would present problems to the regular routine, it is advisable to have a specific area of responsibility, manned by at least one technician, to handle gift items. Since most single decisions would cover multiple items, it is possible for one person to perform this function. Thus, the actual number to be handled as routine check-in lies between these extremes and is estimated by NAL to be approximately 375,000 per year.

Two minutes has been set as a goal for processing time as opposed to the current 3 to 5 minutes per item. If an 80-percent efficiency of the check-in personnel is allowed with respect to 2-minute processing time as well as a 5-year growth of 10 percent per year, then approximately 14 routine checkers will be required. For the initial implementation of this subsystem, 9 will be required. Even with the cut in the average processing time per item, this number is an appreciable increase over the present staff; but it is caused by the increase in total volume resulting from the elimination of present backlogs plus new acquisitions. If the anticipated increase in volume does not occur, the number of staff can be scaled down accordingly.

6. Handling Exceptions

Thus far, only those items that fit neatly into the routine pattern have been accounted for; however, an item may be held up at any one of several points in the check-in process. One of the most likely is the identification step: when no title card is found that matches the item. After a reasonable amount of effort (1 to 4 minutes), the item could be set aside for action by a technician with full access to appropriate portions of the data base. By removing an item from the regular processing, a greater overall efficiency is obtained than if the checker stops the processing flow to obtain help from a more skilled person. If, after the special checker examines the item, a simple instruction will allow identification in the future, the instruction can be attached to the item; and it can be returned to the normal flow. If the instruction would be of general value for that serial, it can be added to the permanent title card. Thus, continual recognition training and updating of the title cards is achieved.

The special checker will need a visual display to allow intellectual interaction with stored information and to make best use of the aid offered by the automated system. Examples of this aid are retrieval of similar titles or titles with specific geographic, subject, language, or other constraints.

7. Renewals

Since most renewals are made on a fairly automatic basis, the automated system can generate (in a form suitable for direct mailing) an order to the source for a renewal subscription, be it a gift, purchase or exchange. Prior to the mailing of such an order, a list of the titles being ordered during a given time period can be printed for review by the serials librarian. It is anticipated that only a small number would require some form of stop action, and such a list could be inputted to the computer with specific action; e.g., hold, cancel, or order at a specific time. Orders for new serial titles will still be handled in acquisitions, but removing a task of such major proportions as serial renewal from the acquisitions function should allow them to concentrate on their more specialized function—the acquiring of new materials. Accounting for the funds expended by the serials functions can be provided automatically for various periods (day, month, quarter) and can be projected into the future as frequently as needed. The data will always be current within the system.

(3) Cataloging and Quality Control Function

As stated previously, much of the routine work now performed in the cataloging activities can be accomplished in the course of fulfilling the acquisitions function. This will enable catalogers to devote more attention to intellectual activity, such as assigning subject terms and the associated Library of Congress classification number.

An important function in any library is the quality control of the records that make up the data files. In an automated system, which is much less tolerant of errors than a purely manual one, this quality control is essential. The personnel presently performing the cataloging functions at NAL already have much of the responsibility in this area, and whatever group performs these functions will be most able to assume the role as final authority for the exact data and format to be inputted to the files. Specifically, such a group will maintain all authority files, determine minimum content of records, and establish definitions of data elements.

Approximately six people associated with the cataloging function will need to use the data base directly and therefore must have access to a CRT/keyboard terminal. This allows for the increased cataloging rates expected with direct file access. Any hard copy outputs needed can be provided by a typewriter output.

(4) Circulation Control Function

Most automated circulation systems have been based upon a batch process, wherein cards with user information and cards for the items borrowed are inputted (after a quantity has been accumulated) to create a record.(3) This record is periodically reviewed to update returns and to determine overdue items so that overdue notices can be produced automatically. With a real-time system, such an updating procedure is unnecessary because the data can be inputted on a remote terminal when the item is brought from the shelf for loan.

The number of expensive CRT terminals can be kept to a minimum if a standard typewriter terminal is used for much of the routine communication with the data base. A simple transactor can be used for checking in volumes.

Some circulation systems use a badge-reader device to input user identification. Because NAL will be located at Beltsville, there will be little "walk-up" borrowing. Thus, it is impractical to issue badges to the approximately 114,000 USDA employees plus all others who would use a national library. If machine-readable cards were produced for each user, mail requests would require either sending in the ID card or NAL's keeping a second card in circulation for inputting. These are both awkward and expensive solutions considering that over 250,000 items were borrowed in 1967 from NAL. Only if a few high-volume organizational users could be identified by one code (not individual members of that organization), would it be worthwhile to add a badge reader for circulation control and to maintain a set of coded badges at NAL for rapid inputting.

(5) Reference Service Function

The reference service function can make use of the entire data base both in real-time and in batch modes. It does not impose any specific constraints on the system and, consequently, has not been subjected to trade-off analysis.

3. SYSTEM DESIGN TRADE-OFF CONSIDERATIONS—FILES

The effectiveness of the NAL automated system depends upon minimizing data storage redundancy and processing structured queries as quickly and economically as possible.

Minimizing redundancy in data storage, with the concomitant minimizing of redundancy in data inputs, can be readily accomplished in any system if the potentially high cost in operating time and complexity is ignored. Selective use of file indexes, chain-linked files, and formatted retrievals will permit the evolution of a system that is cost-effective in the NAL environment.

(1) Structure of the Files

Although maximum efficiency may not be obtained on a given machine, it is possible to use any one of four broad microstructure techniques on any currently available hardware.

1. Fixed format for each element and fixed elements in each data record
2. Fixed format for each element and variable structure of elements in each record

3. Fixed record length with variable fields of elements

4. Completely variable fields of elements and records.

The requirement to handle the elements defined by this study and to allow for new elements to be defined when operating experience dictates precludes the economical use of a completely fixed format. The advantages in search efficiency of the second technique are offset by the wasted storage space for the same reason—inability to specify a narrow length range for each element. The fourth technique makes maximum use of available storage for highly variable records but increases software complexity and search time, thereby reducing CPU utilization. The third technique—the concept of variable length elements combined to form a record that is a fixed length—is applicable to the NAL files.

The basic intent is to have the most frequently used information contained in a fixed length record but variable in length and content with respect to elements. The length distribution function for most elements, such as subject, title, and author data elements, is asymmetrical about the unweighted mean, with a slow trail-off of long entries. Thus, a length near the mean can be chosen that will encompass a high percentage of the entries. For typical random distributions with moderate skew, a value only 20 to 40 percent larger than the mean will include 80 percent or more of the samples even though some samples are several times the mean. The exact length will be selected after the appropriate statistical data has been developed.

It is possible to minimize the dead space created by the number chosen for the fixed length by roughly ordering the primary elements and storing them by importance and frequency of use. For a given number of primary elements, the dead space can be reduced to an arbitrarily small amount by decreasing this fixed length of the primary record. As the fixed length decreases, however, the number of times a second memory location must be addressed to obtain all primary data increases.

All other data (referred to as "supplementary") and overflow primary data is stored in an arbitrary location. Retrieval of this portion of the record is accomplished through an address link (i.e., the machine address of the location) stored at the end of the primary portion of the record. The length of the supplementary portion of the record is not critical because it can be stored in several locations with sequential linkage. In general, some dead space can profitably be left in the supplementary portion when creating new records known to require added data in the near future.

For maximum effectiveness, the elements used in the primary portion of a record must include:

- Data for a basic document report
- Other elements traditionally associated with first-level bibliographic identification or selection of a particular item.

The document report receives the highest priority and, as a minimum, should contain accession number, author, title, NAL Agricultural/Biological Subject Terms, and the location/status code. Other bibliographic identification data for the primary portion of the record should include imprint data, edition statement, conference or meeting, language(s), editor, and other subject information. The relative ordering of the first few elements is not critical because all are included in essentially every instance. The balance of the list is ordered tentatively by a subjective judgment of overall utility and frequency of use. If operating experience indicates another order, or additions and deletions, the new rules can be implemented without updating existing records. Unless a complete and radical difference were found, the consequences of not updating is a very slight increase in average response time on some fraction of the existing records.

The selected documents, taken from the list in Appendix D, are given in Table 1 and are arranged with the highest priority first. In those cases where more than one element would serve the same or similar purpose, all tags are given; but only one data element would be selected. In order that the fixed length of the primary portion of a record can be determined, a range for the average character per element is also given.

The value of the fixed length can be chosen by assuming that the distribution function of lengths is of the type already discussed. Thus, a value of 20 to 40 percent larger than the high average should include at least 80 percent of all the data. This would be approximately 350 characters—plus tags and delimitors (about 40 to 50 characters) for a total of approximately 450 characters. The low value would indicate a total length of approximately 330 characters. To insure near-zero

Table 1
Primary Data Selection List

DATA	NAL TAG	CHARACTERS/ELEMENT
ACCESSION NUMBER	101	8
AUTHOR	211,212 (OR ANY 210 SERIES)	25–30
TITLE	301,302,303,304	45–60
LOCATION STATUS	121	10
AGRICULTURAL BIOLOGICAL SUBJECT TERM	501 (OR OTHER 500 SERIES)	40–50
IMPRINT DATE	413	4–8
PUBLISHER	411	20–25
PLACE OF PUBLICATION	412	10–20
EDITION STATEMENT	418	5–10
LANGUAGE(S)	234,243	10–15
EDITOR	215	25–30
OTHER SUBJECT TERMS	231 TO 236,321 502,503,511 TO 514	40–50
APPROXIMATE AVERAGE DATA TOTAL		240–320

average dead space, it is recommended that a value near the low end (about 375) be used for initial implementation. This will give high average response content with only one memory access.

Certain machine characteristics also influence the microstructure of the record. The characteristics assumed will be typical for current equipment or will be available on standard equipment in the near future, but these should not in any way be construed as design requirements for the system hardware. It is unlikely that other hardware features available at implementation will result in an entirely different microstructure with equal or better overall performance.

For example, assume that the machine has a large repertoire of characters represented by eight-bit fields. With little loss of storage efficiency, one or two characters can be reserved (as provided by the ASCII codes) to indicate the start of a record or element. Thus, the directory usually associated with variable length records is eliminated. Carry this one step further—the basic transfer item from the bulk storage could be a character, word, or block of words. In each case, a different attitude towards record length is appropriate. There is little advantage in input/output or processing time when less than integral multiples of the minimum transfer unit are used, but there is a price to pay in storage efficiency when the transfer unit is larger than the typical record if the remaining memory is left blank.

Another important feature that would allow considerable leeway in file organization is a capability for performing logical operations in a buffered input channel. If the peripheral unit can search a given block of bulk storage by being given a start address, a stop address, and a comparison mask, a considerable CPU time-saving is gained because transfer to core storage only occurs when wanted data is located. This feature would remove much of the burden that the sophistication in file structure places upon the software because searching time can be allowed to increase by an order of magnitude without an overall response-time problem. An even greater flexibility in file structure is possible if simple satellite computers are used in the primary input/output channel with the bulk memory. Whether either of these techniques will be incorporated is dictated primarily by the particular hardware configurations available economically from a given vendor.

(2) Contents of the Files

The impact of the Library of Congress MARC II and National Serials Data Program(4, 5) should be discussed with respect to the NAL data base before detailing the NAL elements. The structure and design of the MARC II (Machine-Readable Cataloging) communications format is based upon the requirement for "distributing Library of Congress cataloging in machine-readable form to a variety of users" so that "bibliographic display in a variety of forms (3 x 5 cards, book catalogs, bibliographies, etc.)" can be produced in "an individual local format."(6) (The current transmission media is magnetic tape.)

It is possible for any specific library system to evolve a more hierarchically structured organization of the data for internal storage to allow more efficient searching and more straightforward software. The penalty for such enhancement, however, is the necessity of "translating" tags when transferring data between the communications tape and the internal mass storage, a simple operation that can be performed if MARC II is inputted or outputted.(7) It is essential to the NAL goal of fostering universality in the library community, and especially among the national libraries, that all data produced outside NAL in the MARC II format must be accepted by the automated Document Location and Control System (DLCS) for later internal processing.

Another specific national program that could influence the detailed structure of the data base is the National Serials Data Program, jointly sponsored by the three national libraries but primarily conducted by the Library of Congress. This program has initiated discussions on many of the major issues pertinent to the creation of serials-oriented standards. Unfortunately, the program has not yet developed firm data elements or formats for a national serials project.

The data elements are not based upon normal trade-off analysis. Many are dictated or suggested by:

- Specific system requirements provided by NAL
- The MARC II program
- The intent of the National Serials Data Program
- Specific needs of the automated Document Location and Control System.

In addition, a general attitude of providing for essentially any type of data element is maintained. Thus, suggestions by the

NAL staff on what is desirable data and as well as data identified by the study team are included. The flexibility for variation in data content is a direct consequence of the selected file structure; however, it should be emphasized that discrimination in selecting data for inclusion in a particular record is still a requirement even though it will be possible to include any data. In no other way can a system be implemented that will adequately respond to the inevitable dynamics of automation and library technology. A list of the elements selected constitutes Appendix D.

(3) Index Structure

Certain categories of data elements provide minimum logical access to the records in the bibliographic record file. These categories are:

- Control Number
- Author
- Title
- Subject Term/Descriptor.

These entry points provide rapid and easy access to the basic data record for each item in the NAL collection and warrant special indexes. If, however, at some time after implementation an additional access category is deemed desirable, it will be a simple matter to search the total data base for this element in order to create a new index. This is a one-time operation and can be run against the operating system as background. The only additional cost will be the added storage for a new index.

In the future, the basic physical locator at NAL will be an arbitrarily assigned accession number. There is no need to have an inverted index of the NAL classification number in addition to the accession number because the subject term serves approximately the same purpose. All that is required for access by accession number is the data needed to implement the algorithm that converts accession number to memory location. Thus, a complete accession by accession number index is not necessary.

The Author Index can contain all forms of author without distinction—personal, corporate, conference or meeting, etc. The only purpose of these entries is to locate the basic record of the item; therefore, each different author will require an individual entry.

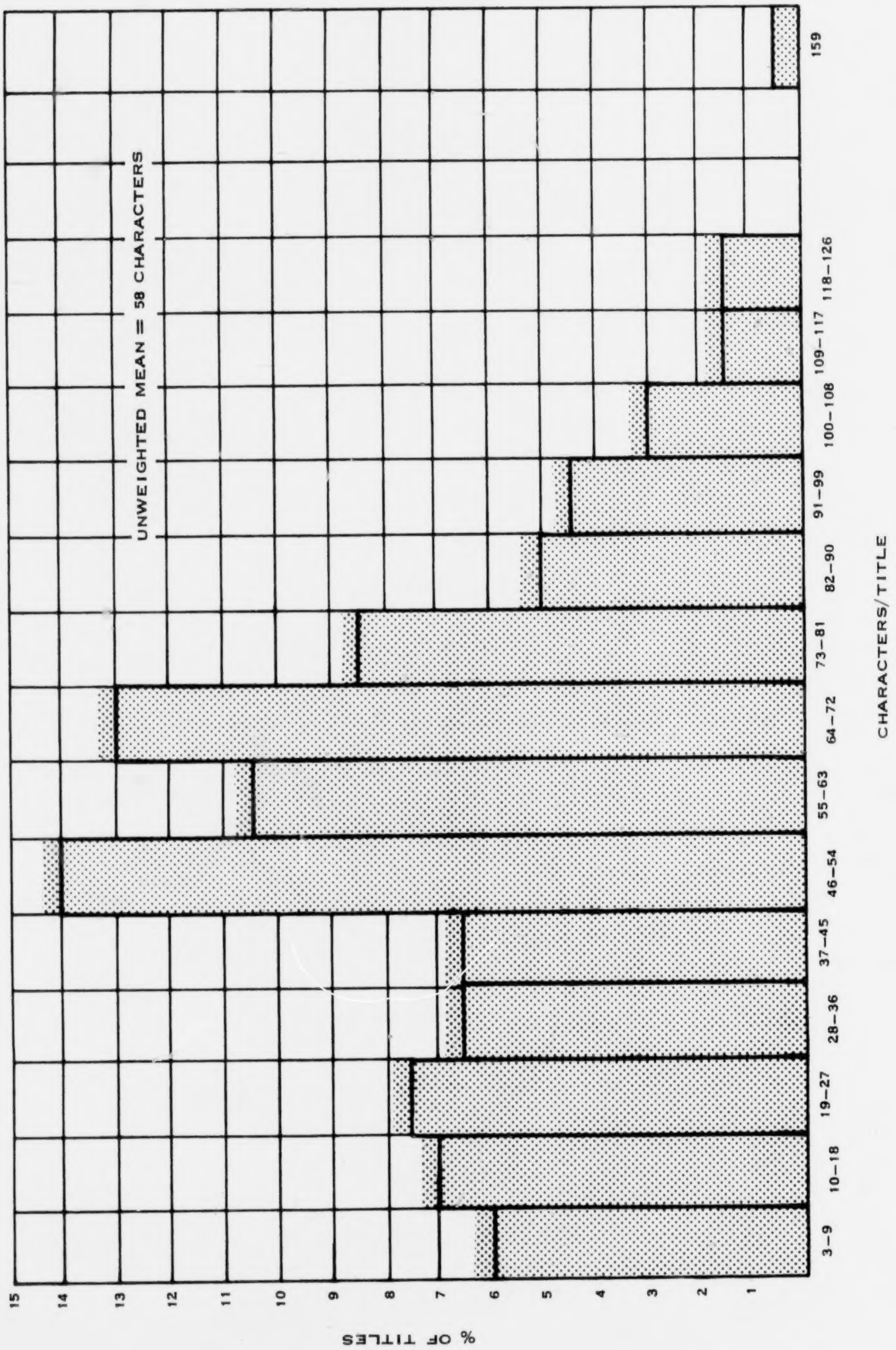
In the same manner, the Title Index can contain a variety of title forms.(8) As a minimum, it should have one full title for each entry in the data base; however, if the file is a simple alphabetic listing, there is no limit to the number of titles that can be included for a single item. For example, the elements being discussed for the National Serials Data Program include over 10 distinct kinds of titles. When the essential intent is to respond to a query with location and bibliographic data, it is not necessary for the system to distinguish various forms of title in a search. In fact, an input requirement such as this would be an unwarranted burden on the user, whose only desire is to locate the main record as quickly as possible.

Although subject entries have not been emphasized in this study, an allowance has been made for a file of the NAL Agricultural/Biological Terms and for the accession numbers of those items with each term. Hierarchical cross-references should be considered for incorporation at a later date when the more basic problems of the overall automated system have been solved.

The simplest structure for the indexes would be a fixed length for each entry with allowances for the maximum length in each case; however, the wide spread of these variables would make such an approach very wasteful of storage space. A good compromise is to use again a fixed length that includes a large percentage of the elements considered. When the length exceeds this number, an address link can be used to locate the remainder of the record. In the search, this would only be done when a match on the first part occurred. Thus, in a very few cases would an unnecessary retrieval cycle be required.

To determine the value of the fixed length, a study of the distribution function for titles was conducted. A statistical survey of the length of titles in serials indexed by the Bibliography of Agriculture was made. The resulting distribution function, based upon a 2-percent random sample, is shown in a chart, Figure 2. The distribution function of other elements will be essentially the same shape, but the mean will be shifted. From the chart, it can be seen that a value 35 percent over the mean includes 80 percent of the entries and provides a good basis for the following selection of the fixed length (exclusive of the related accession numbers) of the index entries:

FIGURE 2
Distribution Function Bibliography of Agriculture Serials



	Average Length	Fixed Length
Author	25-30	37
Title	45-60	70
Subject	40-50	60

The errors in this fixed length have a somewhat greater consequence than those associated with the primary record fixed length because the indexes will contain nonzero dead space; however, the total size in only 10 to 20 percent of the total storage and the penalty of the dead space will be outweighed by much faster search times needed in answering each query. Specific size numbers are derived in the next section.

(4) Size of the Files

The purpose of quantifying the total data base at a particular point in time is to gauge the class of hardware required and to establish expected system cost. The nature of NAL's expected growth dictates that modular memory techniques be used to allow expansion hopefully at a constant cost per character. An error in the size estimate on the high side will result in equipment that is idle until growth encompasses the excess. An error on the low side will result in delays in implementation if the error is not discovered in time.

The massive data-base conversion required to automate NAL requires an effort spread over appreciable time. Thus, there will be a point when data is available to refine the estimates and to modify procurements while the system contractor is still designing and installing the hardware/software package. Even if no attempt were made to adjust the amount of idle hardware, a 50 percent over-acquisition, not fully utilized for 3 years, would produce only a 5 to 7 percent effective-cost penalty. (This is based upon equivalent rental prices of the purchase cost developed in Chapter IV.)

The most critical factors in the file sizing are:

- Period of time covered by initial conversion and, consequently, the number of item records at implementation
- Quantity of data per record including indexes
- Magnitude of data used to support the DLCS and nonbibliographic requirements
- Rate of growth of the NAL collection.

The first and last factors are management decisions about the library, but the specific number of items that occurs should be monitored during implementation. The other two factors also warrant special monitoring to provide the basis for short-term decisions. To provide more detailed guidelines, two sizes have been developed. The size at implementation is based upon late 1969 and early 1970 estimates; the other estimate is projected 5 years hence for late 1973.

Current thinking at NAL is that initial data conversion should begin with 1966. This would be a reasonable undertaking, but consideration should be given to eventual conversion of earlier data. A sound technique is to continue conversion after system implementation and work back in time from 1966 while keeping pace with new growth. This may be done by providing for a higher-than-actual growth rate and by diverting the excess capacity to conversion. The margin, however, cannot be too large or it will increase system cost appreciably. The growth rate of NAL is so strongly influenced by decisions on future acquisition policies that prior library experience is not directly applicable. A growth rate based upon the maximum feasible in the near future—10 to 20 percent a year including backlog conversion—is projected.

The approximate number of monographs for the 1966-1970 period will be approximately 90,000 to 110,000 unless acquisitions in 1969-1970 are very high. By the end of 1970, the annual rate is estimated to be 25,000 to 30,000 per year, and, with the projected growth rate, this results in a total of 205,000 to 265,000 monograph records in the data base by 1973.

The serial titles now in the current serial records file plus the serial titles of the Law, Bee Culture, and Seed Catalog collections number almost 30,000 at the present time. The growth rate for serial titles, however, cannot be expected to be the same level as for monographs because the continuing nature of serial tends to reduce the total population expansion rate. For this reason, a maximum of 10 percent and a minimum of 5 percent are estimated for serial title growth. For implementation, this would result in 30,000 to 33,000 records; in 1973, this would be 35,000 to 44,000 records.

Many studies have been conducted to determine the number of characters to convert catalog data to machine-readable form. One such study was conducted on data in the National Union Catalog.(9) Although it indicated that approximately 300 characters are required for a monograph, the range of data contained was much less than the elements considered for the DLCS; and the number of distinct data elements was more than double that for the DLCS. Unfortunately, a simple linear extrapolation of the length based upon the number of elements is not valid because much of the additional data contains notes and other lengthy records. But, if local administrative data is neglected, the generation of only so much information about an item is possible unless attempts are made to include detailed contents, notes, or abstracts. In summary, the limits of the record size are based upon the following:

- The quantity of bibliographc data content is about twice the standard card catalog (i. e., 550 to 650 characters).
- The local administrative data is efficiently coded so that the 15 to 20 elements concerned with circulation, user statistics, etc., require only 100 characters.
- The number of distinct elements present is always much less than the maximum possible or, in other words, about 50 to 60 tags are required (i. e., 200 to 250 characters including delimitors).

Thus, the average monographic record length is between 850 and 1,000 characters.

The serial record contains much of the same data as the monograph, but some elements are not likely (e. g., most of the entries involving author). It is estimated that this amounts to no more than 100 characters; however, the data unique to serials involves nearly 25 distinct elements, most of which are always present. The holding elements will be repeated many times, and the binding statements are lengthy. A typical serial will have 5 to 10 years of holdings data, a few supplements and indexes, detailed binding instructions, and adequate frequency/claims information. This is estimated to require a net increase of 250 to 400 data characters and an 80 to 90 tag/delimitor characters over the monographs. Thus, the average serial record size is estimated to be between 1,200 and 1,500 characters.

Each of the indexes must be sized separately. The author index will contain at least one author for each monograph and in many cases, several authors. In the past, the number of authors per item has been arbitrarily truncated to three; this can be used to set the upper limit. It is also intended that the same author be repeated in the index with variations in form or spelling. As a result, there should be between two and three author entries for each monograph. The length of each entry will be the fixed length plus one accession number (the overflow is small enough to neglect), or approximately 45 characters.

The Title Index will contain at least one title for each monograph and serial record. For completeness, however, many subtitles and truncated titles should be included. How many will be determined by the amount of effort expended, but, hopefully, 10 to 20 percent of the records would have at least one other title entry; the size estimate includes this assumption. Each entry will contain one accession number and will have a length of approximately 80 characters.

The NAL Agricultural/Biological Vocabulary now contains 42,000 entries. Its projected growth is an increase to 200,000. A minimum of three to four terms should be assigned to each monograph or serial to obtain adequate specificity. The size of the index is obtained by adding the total number of characters in the fixed length portion that contains the subject term and the memory address link (approximately 70 characters) to the number of accession numbers in the index.

By taking the extreme of each estimate—number of records, number of entries per record, etc.—a worst-case range for each index can be determined for the two time periods. These estimates for the Author, Title, and Subject Indexes are summarized in Table 2.

Table 2
Index Size Estimates

	1969–1970	1973
AUTHOR	$8-15 \times 10^6$	$18-36 \times 10^6$
TITLE	11–14	21–30
SUBJECT	6–8	21–25
TOTALS	25–37	60–91

Certain secondary files will be needed for the general operation of NAL; their exact contents are described in Chapter IV. A file of information on 12,000 vendors/sources will require four to five million characters. Name and address data for 100,000 borrowers will require an additional 12 to 15 million characters (somewhat less at implementation). For operating statistics and financial data, as outlined in Appendix B, 500,000 characters are reserved. The overall limits of all the file sizes are summarized in Table 3.

Table 3
Overall File Size Summary

	1969–1970	1973
MONOGRAPH RECORDS	$76–110 \times 10^6$	$175–265 \times 10^6$
SERIAL RECORDS	36–50	42–66
INDEXER	25–37	60–91
SOURCE FILE	4–5	4–5
USER FILE	10–12	12–15
STATISTICS AND FINANCIAL DATA	0.5	0.5
APPROXIMATE TOTAL	150–215	295–440

The trade-offs with respect to file size are reflected in all parts of this report. In a broad theoretical sense, the system is the files; therefore, the effect of each design consideration on the files must be weighed carefully. In the long term, however, the total memory required is dependent upon intelligent restraint in allowing policies that encourage the inputting of unnecessary, ill-defined or redundant data, or policies that prevent the periodic weeding of such data when it is so identified.

4. SYSTEM DESIGN TRADE-OFF CONSIDERATIONS—HARDWARE AND SOFTWARE

Within the system design, which supports the operational system, there is an almost infinite choice of hardware component combinations, each of which have technical and cost implications. Thus, the system design is the result of a successive selection of hardware alternatives (main frame, storage devices, remote terminals, and character set) and the resulting software capabilities.

(1) Main Frame

The specific system characteristics that determine the required Central Processing Unit (CPU) are:

- Number of remote terminals
- Total request rate from all terminals
- Average number of basic CPU operations per formatted retrieval.

The CPU is primarily for handling transfer to and from memory and for straightforward comparisons, rearranging, and formatting. To handle the 40 to 50 terminals needed for a full-scale automation of NAL, sufficient input/output channels must be available. These may either be within the CPU, or be in the form of branching input/output channel controllers. All required remote terminals must be accommodated on a demand basis within the response-time requirements of the system.

Remote interfaces may be serviced in two basic ways: synchronously or asynchronously. The synchronous technique is characterized by a regular sequence of checking terminals to see if a request for service has been generated. Variations in individual terminal use can be accommodated by putting them in the sequence a varying number of times. The asynchronous technique is based upon each terminal being able to address the CPU at any time. This request for service is acknowledged in near real-time and note is taken of the need to service the terminal. This is called a "real-time interrupt" even if the total service operation is completed at some later time. In a system with constant demand rates from all terminals and predictable service times, the synchronous system is adequate; each terminal may be queried and serviced in turn. In a system having a large number of terminals requesting service essentially at random and having the variations in the type of request cause variations in the service time, the real-time interrupt feature is more applicable. Although relatively long delay times (about 500 milliseconds) are imposed by the form of bulk storage recommended for this system, the asynchronous interface servicing scheme permits the terminal functions to be interwoven for maximum utilization of a given CPU while minimizing the average delay time encountered at any one terminal.

There are many attractive features advertised as available in current hardware being used in large-scale, real-time systems. Unfortunately, a substantial portion of these hardware capabilities are primarily for scientific computation. The NAL system will benefit from built-in features to increase memory utilization (such as paging and memory mapping). The presence of these features will outweigh any deficiencies in the features associated with large-scale scientific computations (e.g., scratch pad memories or floating point arithmetic).

The number of daily transactions predicted in 5 years will be over 8,000 or, based upon an 8-hour working day, about one transaction every 3.6 seconds. To complete most transactions, two to four passes through various computer programs of 1,000 to 5,000 steps each will be sufficient. The slowest third-generation CPU's are capable of meeting this workload because they can process a mix of commands at a rate in excess of 10,000 per second. Most of the CPU's with sufficient input/output capability generally have processing speeds two to five times this rate. Thus, considerable growth allowance is provided in the number of terminals and in the amount of processing needed for each transaction. An ample margin is also allowed for reliable background processing of batch jobs.

(2) Storage Devices

The primary storage medium for the files in this system must be large, must be relatively low in cost per bit stored, and must have random, moderately fast access. In terms of the dynamic storage requirements, NAL requires a relatively large data base of 300 to 400 million characters for the period from 1966 to 1973. Even in a no-growth situation, to implement such a relatively large data base on magnetic tape is to incur technical and operating problems that are not immediately justified on an economic basis. Magnetic tape cannot be addressed directly; it must be addressed sequentially. Storage capacities can be increased by the use of multiple tape-handling units and by multiple reels of tape; however, the access time ranges between 3 milliseconds and 10 minutes, depending upon the tape position and the number of reels searched. Such a slow operation is not considered compatible with real-time operation, nor is it determined to be economically feasible for NAL.

The utilization of a Data Cell or similar strip type of storage with a capacity of up to 400 million characters per bit and access time of approximately 500 milliseconds appears to be the most cost-effective alternative for the basic record storage. The Data Cell has an initial cost of $140,000 plus $500 monthly maintenance cost, or about 0.04 cent per character stored over a 5-year period. This represents a highly economic storage medium when it is used at or near its capacity. The Data Cells currently installed, however, are constrained in the number of times a given storage strip can be addressed without permanent deterioration. Before these units can be used, this defect must be corrected by the manufacturer so that some assurance of successful long-term operation can be given.

Another alternative is to delay the bulk memory until a later time in implementation since the initial requirements can be satisfied by a disk unit. The storage capacity of a bulk disk unit is approximately 200 million characters. Its purchase price is approximately $250,000 plus about $600 monthly maintenance or about 0.14 cent per character stored over a 5-year period. The disk has an access time of one third to one fifth that of the Data Cell. This higher speed allows a straightforward allocation of the interrupt priorities and somewhat simpler software.

Another feature that would be beneficial is a self-contained memory unit that can accept and provide data directly to an input/output channel under the control of the CPU but not through it. This may be accomplished by having the CPU identify start and stop addresses and by having it begin the operation when an input/output interrupt occurs. After that, the CPU may go on to other tasks, thus having saved appreciable time in a system with as many total transfers to and from bulk memory as is expected in this system.

(3) Remote Terminals

System output considerations are determined by the urgency and frequency of response required, the type of format, and the ultimate storage or disposal considerations. Remote terminals are the most attractive means of providing the librarian with immediate access to the entire data file. The generic categories of terminals under consideration are cathode-ray tube (CRT) terminal, the typewriter, the small multiple-character printer, and combinations of these.

For those work stations where the inputting of new data is accomplished, a highly-readable CRT terminal with its own internal buffering is needed. Logic for addition or deletion of a character, word, line, or larger element must be included if many terminals are to be served by an economical central facility; however, formatting and elaborate manipulation of the data can still be done by the CPU. A built-in protection of the files is also needed. In some cases, this will be accomplished by allowing read-only operation while in those cases where data input for permanent storage is routine, a positive review and transfer action will be required. The use of a remote terminal is explained in Appendix G by examples of operational alternatives.

(4) Character Sets

Traditionally, the librarian has felt the need for an extensive character set to represent most completely and explicitly the bibliographic information of a document. The introduction of various labor-saving devices, beginning in the nineteenth century with the typewriter, has necessitated limiting the total number of symbols used. Essentially, there are three aspects to this problem, and emphasizing any one results in markedly different system designs. These aspects are:

1. Retention of useful information
2. Human engineering of the transcription process
3. Cost (both capital and operational) for transcription.

The Library of Congress heavily emphasized the first aspect and is using a character set for MARC II that currently exceeds 170 characters. (No final standard has been released.) The National Library of Medicine (NLM), in order to implement an extensive overall system immediately and at reasonable cost, is using a character set that is roughly half that size. Thus, NLM has decided that a character set inputted on a keyboard familiar to a typist is adequate for the initial years of MEDLARS II.

In a sense, NAL decided this issue when an NAL character set was established for procurring typewriters. Without specific regard to the requirements of automation, a decision was made to limit the total number of symbols and functions to conventional typewriter standards. Non-Roman alphabets and most specialized symbols have been excluded, and rules for treatment of specific languages, including transliteration, have been established. A reasonable number of special, non-English representations are possible by using the limited set of diacritical marks, both spacing and non-spacing. This approach has successfully guided the production of much of NAL's manual data base. Thus, the fundamental nature of the data generated and stored (in this case, the card catalog) was established.

With the incorporation of NAL into a national program of automation, however, some of these decisions must be reviewed. Specifically, the question that must be answered is: to what extent will the new DLCS make use of the large number of characters in MARC II? Cost and available hardware constraints lead to three distinct alternatives.

CASE I

Use a standard 49-key input device (88 characters plus 6 function keys), and store only 6-bit characters. Use stored shift character to achieve upper and lower case and certain symbols. Ignore shift key on visual displays. Compatibility with MARC II on output is achieved by using a subset of MARC II characters.

Advantages

- Lowest cost
- Straightforward input/output
- Widest choice of hardware.

Disadvantages

- Does not meet American Standard Code for Information Interchange (ASCII) specifications
- MARC II data truncated on input.

CASE IIA

Use standard typewriter keyboard as in Case I, but use full 8-bit characters; use no shift character, but use shift key to create additional character codes. The standard characters selected are an exact subset of the MARC II set using an identical coder. All

MARC II characters not provided for on standard keyboard are translated into one or more characters when MARC tapes are inputted. Displays will handle as many characters and symbols as available without special design or unreasonable cost.

Advantages

- Meets ASCII specifications
- Moderate cost
- Straightforward input/output
- Simple internal machine-handling of data
- Machine compatibility with MARC II.

Disadvantages

- Some MARC II data truncated
- MARC II outputs in a subset of full character set
- Storage requirements 33 percent higher than in Case I.

CASE IIB

Use same as in Case IIA, but store entire MARC II character set as received. One special station is available for inputting all MARC II characters. Print outputs by photocomposition.

Advantage

Ability to reoutput MARC II data in original form and to originate limited amounts of MARC II records in full character set.

Disadvantage

Translation (and consequently machine time) required each time data is used internally in system.

CASE III

Full compatibility with MARC II character set at all stations including displays and local printouts.

Advantage

MARC II outputs in full character set.

Disadvantages

- Extremely high cost of design and development program for special input/output devices
- Elaborate keyboards for all input/output
- Special training program to develop inputting skills.

For initial implementation, the study team has based the design described in Chapter IV upon CASE IIA for the following reasons:

- Ability to communicate at reasonable cost data of essentially the same value to the ultimate user as those containing a small number of infrequently used characters
- Ability to use MARC II tapes from other sources without increasing the time of internal processing
- Ability to convert without changing hardware or existing data base to CASE IIB if required by the standards of future agreement or to CASE III if it becomes economically feasible.

(5) Software

Because 75 percent of the queries will be processed in a time less than the average access to the bulk storage (about 400 milliseconds), it will be advantageous to use multiprogramming to allow the executive or overseer program to work on one or more queries while another query awaits data being brought into the core. Otherwise, elaborate querying and priority schemes must be added to the software in order for the system to flow smoothly. Dynamic allocation of memory is needed to allow more efficient utilization of core memory and to minimize the need to read onto a disk the program routines and data awaiting more inputs, either from the terminal or the bulk memory. If the hardware also has a paging feature, it will be even simpler to ensure efficient core utilization.

Real-time processing is mandatory for any transaction involving a sequence of interdependent questions; however, some operations will be accomplished more efficiently by routine batch processing. Typical routine batch operations include:

- Lengthy printouts
- Elaborate file manipulations
- One-time statistical studies
- Accounting summaries
- Routine printouts of forms for mailing (e.g., orders, subscription renewals, etc.).

Another application of batch processing also has certain advantages in a system of this size. By accumulating real-time inputs, primarily in the area of file updates, until a large number need processing, less overall CPU time is needed. This is especially true of alphabetic file updates because less total file manipulation is required to make several simultaneous revisions than is required to handle each one independently.

It is important, however, that these updates be done frequently (at least once a day) even if the chosen number has not been accumulated. The interim file awaiting inclusion can be searched when an input is not found in the permanent file.

CHAPTER IV

SYSTEM DESIGN

CHAPTER IV

SYSTEM DESIGN

This chapter describes the characteristics of the recommended automated system. These characteristics have been derived from the analysis, in Chapter III, of alternate operational concepts and hardware component trade-offs.

Without repeating the selection logic, this chapter describes and specifies the functional subsystems of the recommended system design. The recommended rationale for the automated operations and automated files for data base development are explained, and the functional performance descriptions recommended for the hardware and software are discussed.

1. AUTOMATED OPERATIONS

The NAL automated system is designed to encompass all the major functions currently being accomplished in the manual system; however, many time-consuming and redundant tasks have been eliminated. In the automated system, many tasks will be accomplished in a shorter time than is required in the current system. This time reduction is most pronounced in instances that now require several files to be consulted or manual clerical tasks to be performed.

The degree of automation will vary from function to function, but every aspect of NAL will be affected in some fashion. The functions are those having the closest interface with the automated system:

- Acquisition
    - Ordering
    - Receipting
    - Descriptive cataloging
    - Claiming
- Serial Record and Control
    - Serial check-in
    - Renewals
    - Claims
    - Binding notices
    - Routing
- Cataloging
    - Use of authorities in the data base
    - Review of completed record before transfer to permanent data base
- Circulation Control
    - Document status reports
    - Checkout
    - Overdue claims
    - Check-in
    - Reserve

- Reference

  - General bibliographic questions
  - Short demand bibliographic listing
  - Aid to general reference.

(1) Acquisition

The acquisition program enables NAL to fulfill its role as a storehouse of world literature in its field. The acquisition function includes the selecting, acquiring, recordkeeping, and record-initiating for all purchase, gift, and exchange items to be added to the existing collection. In a totally integrated data-processing system, the flow of information logically begins with these acquisition activities because they are the initial source of automated item records.

The acquisition process begins with the manual selection, by professional personnel, of the items to be purchased or to be requested as an exchange or a gift. To determine if the citations selected are already in the system or are on order, a technician with access to a CRT/keyboard inputs each title and author. The system responds with what is in the data base, if anything. If the item is not in the collection (or if more copies are desired), the technician will input to the intermediate data base as much of the descriptive cataloging data, price data, etc., as is then available as well as pertinent routing information (e.g., this item goes to circulation after cataloging, or this goes directly to the stacks, etc.).

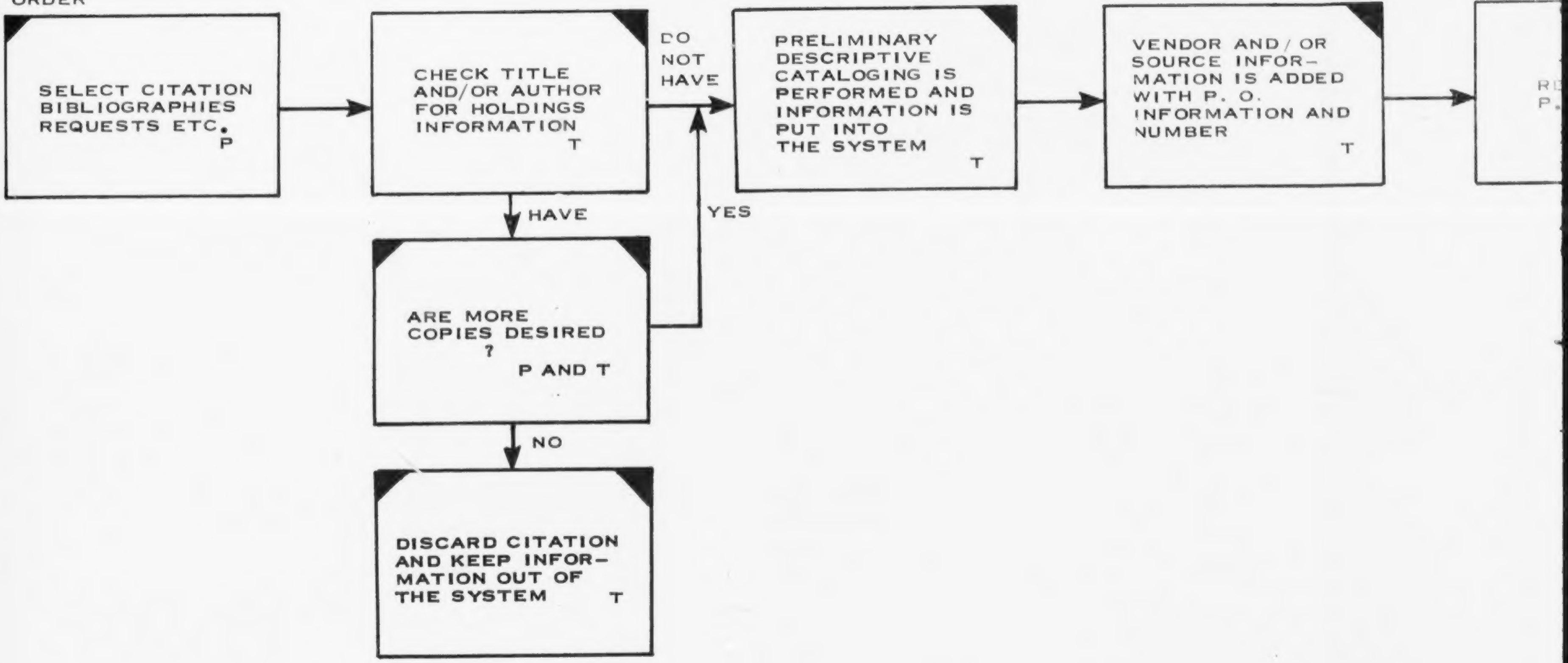
When the initial record has been completed, the source file is consulted; and the technician selects one by inputting the source code. The system responds with a CRT display of the formatted order so that the technician can check for accuracy and completeness. When he has verified the order, he initiates a transfer to the list of orders to be outputted in the next batch at the central computing facility.

During the preparation of the orders, the funds being committed for the acquisitions are compared against the remaining funds appropriated for this purpose. Dynamic records of funds allocated, funds expended, and funds committed (but not yet expended) for acquiring documents are maintained for this automatic check and for management surveillance. Should the level of fund commitments exceed the available funds, the orders will still be printed; but a notice will also be issued to hold the orders until a management review has occurred. The orders can be either mailed directly or routed through an at or near the CRT display. If the routing is other than to cataloging, a routing sticker is also outputted with the appropriate destination. The item and the label are given to a clerk who affixes the label and adds the property stamp and pocket for a machine-readable card. A punched card with accession number, prepared by the computer system, is inserted in a pocket by a clerk who is working with an accumulation of receipted books.

Frequently, unordered items are received and, after review, are selected for addition to the collection. In such cases, the data base is checked to see if the item is already in the collection. If it is, the item may be kept as a duplicate, thus requiring only the changing of the "number of copies" data element. If it is not, the process employed is the same as that for ordered items except that all descriptive cataloging is inputted at one time. An overall diagram of the information flow within the acquisition function is shown in Figure 3.

The display on the CRT that will be used for inputting descriptive cataloging information is shown in Figure 4. Each data element of the display is numbered to facilitate reference to the element for modification; other elements can be referred

ORDER


SELECT CITATION BIBLIOGRAPHIES REQUESTS ETC.
P
CHECK TITLE AND/OR AUTHOR FOR HOLDINGS INFORMATION
T
DO NOT HAVE
PRELIMINARY DESCRIPTIVE CATALOGING IS PERFORMED AND INFORMATION IS PUT INTO THE SYSTEM
T
VENDOR AND/OR SOURCE INFORMATION IS ADDED WITH P. O. INFORMATION AND NUMBER
T
RD
P.
HAVE
YES
ARE MORE COPIES DESIRED ?
P AND T
NO
DISCARD CITATION AND KEEP INFORMATION OUT OF THE SYSTEM
T

RECEIPT

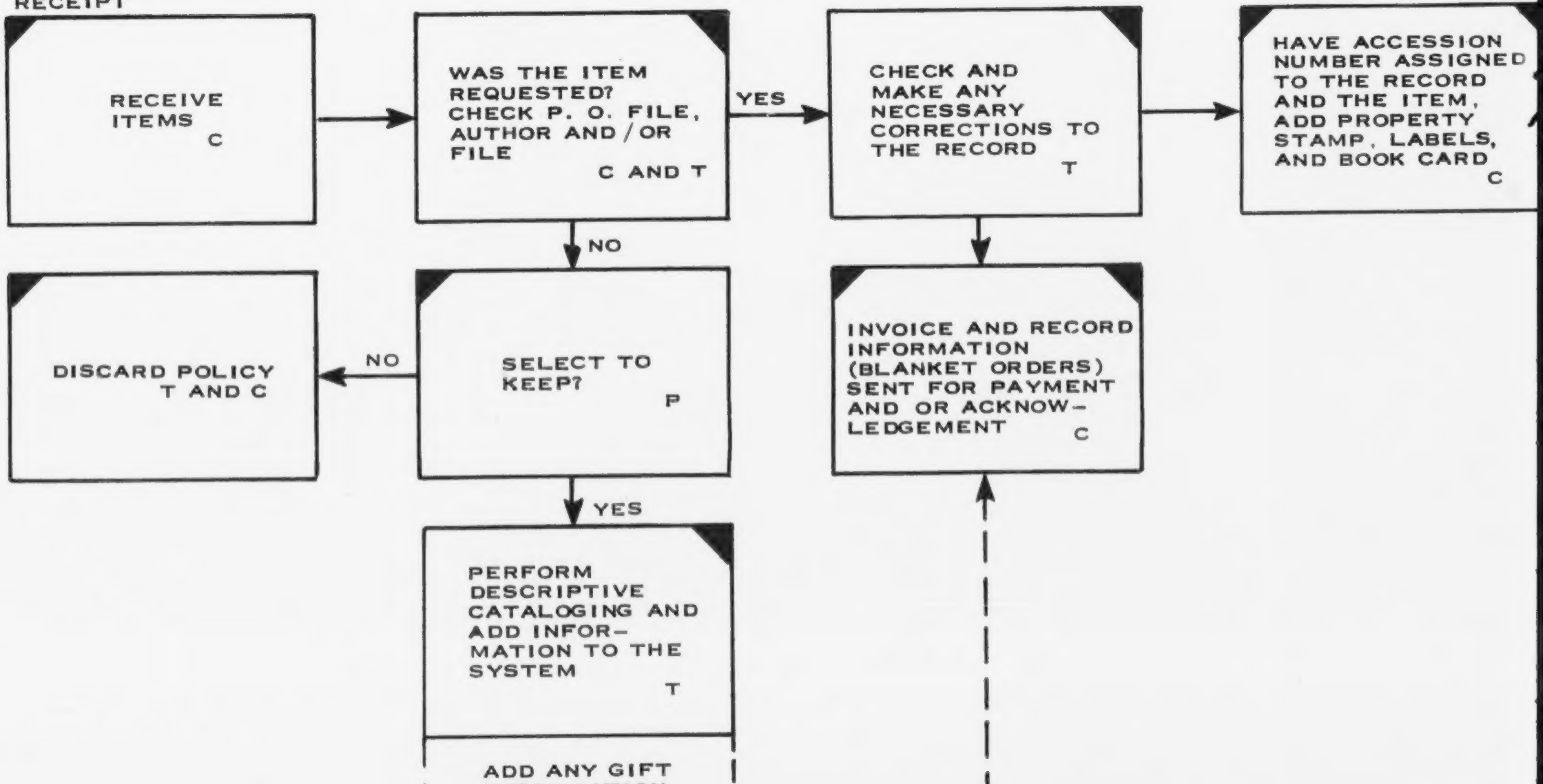

RECEIVE ITEMS
C
WAS THE ITEM REQUESTED? CHECK P. O. FILE, AUTHOR AND/OR FILE
C AND T
YES
CHECK AND MAKE ANY NECESSARY CORRECTIONS TO THE RECORD
T
HAVE ACCESSION NUMBER ASSIGNED TO THE RECORD AND THE ITEM, ADD PROPERTY STAMP, LABELS, AND BOOK CARD
C
NO
DISCARD POLICY
T AND C
NO
SELECT TO KEEP?
P
INVOICE AND RECORD INFORMATION (BLANKET ORDERS) SENT FOR PAYMENT AND OR ACKNOWLEDGEMENT
C
YES
PERFORM DESCRIPTIVE CATALOGING AND ADD INFORMATION TO THE SYSTEM
T
ADD ANY GIFT INFORMATION, BLANKET ORDER INFORMATION, ETC.

FIGURE 3
Acquisition Flow Chart

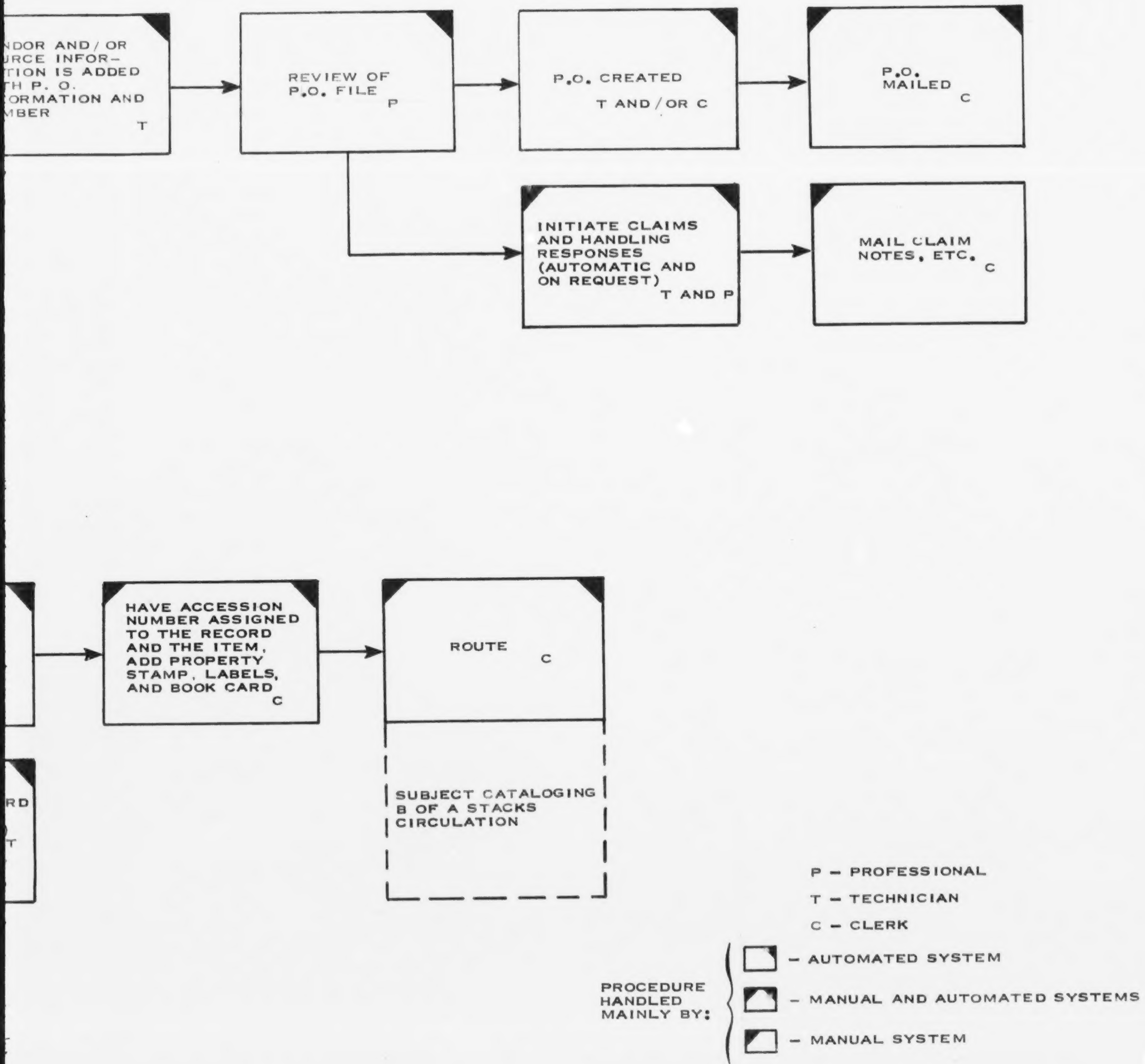
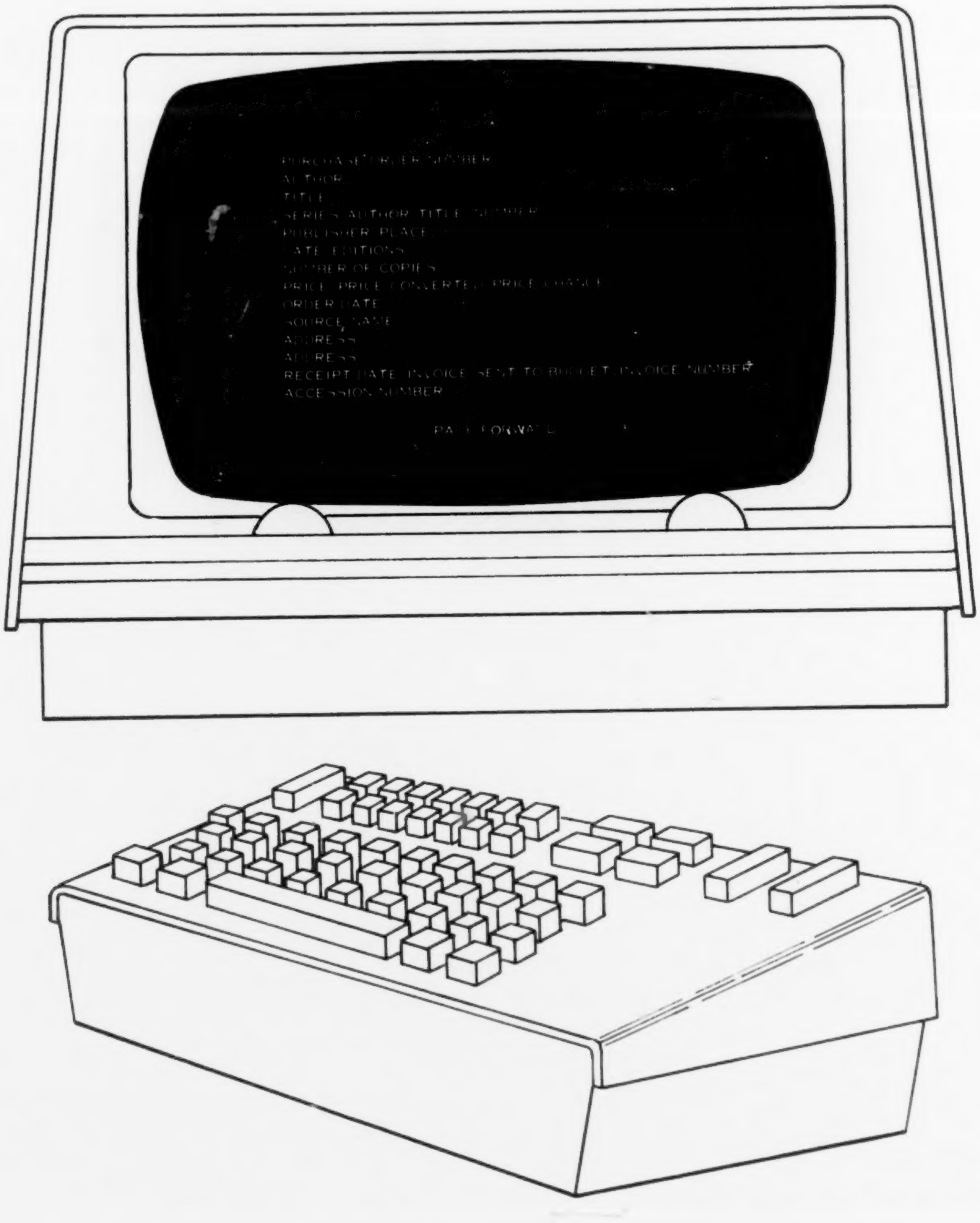
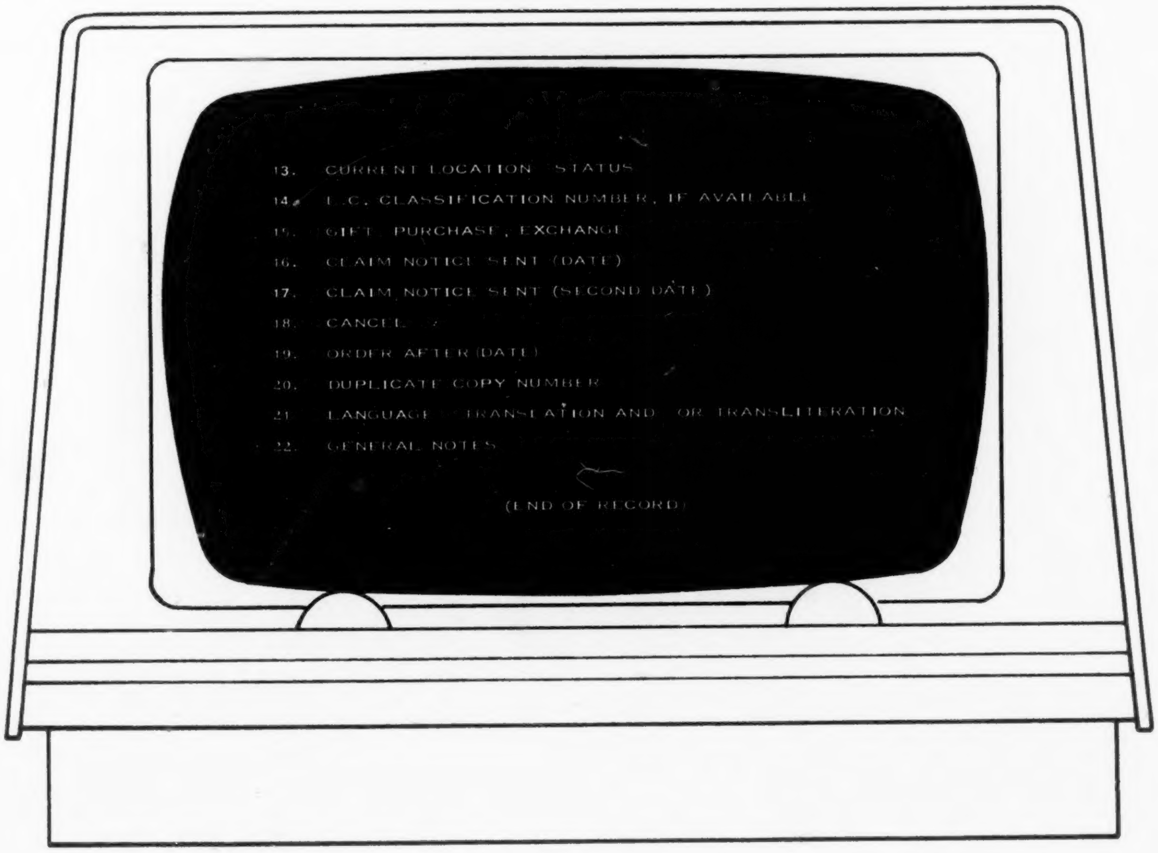

NDOR AND/OR
URCE INFOR-
TION IS ADDED
TH P. O.
ORMATION AND
MBER
T
REVIEW OF
P.O. FILE
P
P.O. CREATED
T AND/OR C
P.O.
MAILED
C
INITIATE CLAIMS
AND HANDLING
RESPONSES
(AUTOMATIC AND
ON REQUEST)
T AND P
MAIL CLAIM
NOTES, ETC.
C
HAVE ACCESSION
NUMBER ASSIGNED
TO THE RECORD
AND THE ITEM,
ADD PROPERTY
STAMP, LABELS,
AND BOOK CARD
C
ROUTE
C
SUBJECT CATALOGING
B OF A STACKS
CIRCULATION
RD
T
P - PROFESSIONAL
T - TECHNICIAN
C - CLERK
PROCEDURE
HANDLED
MAINLY BY:
- AUTOMATED SYSTEM
- MANUAL AND AUTOMATED SYSTEMS
- MANUAL SYSTEM

FIGURE 4
Acquisition Display
(Sheet 1 of 2)



```
PURCHASE ORDER NUMBER
AUTHOR
TITLE
SERIES AUTHOR TITLE NUMBER
PUBLISHER PLACE
DATE EDITIONS
NUMBER OF COPIES
PRICE PRICE CONVERTED PRICE CHANGE
ORDER DATE
SOURCE NAME
ADDRESS
ADDRESS
RECEIPT DATE INVOICE SENT TO BUDGET INVOICE NUMBER
ACCESSION NUMBER

            PAGE FORWARD
```

FIGURE 4
Acquisition Display
(Sheet 2 of 2)



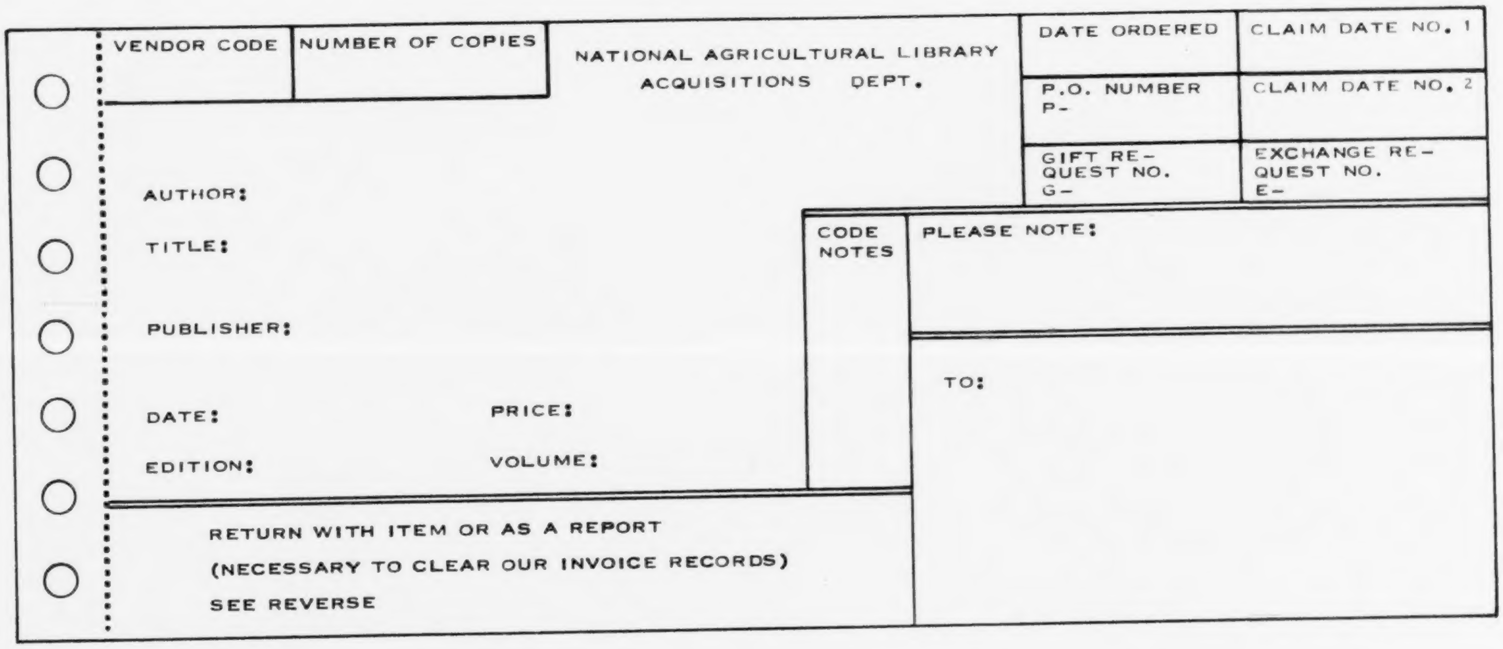
```
13.   CURRENT LOCATION/STATUS
14.   L.C. CLASSIFICATION NUMBER, IF AVAILABLE
15.   GIFT, PURCHASE, EXCHANGE
16.   CLAIM NOTICE SENT (DATE)
17.   CLAIM NOTICE SENT (SECOND DATE)
18.   CANCEL
19.   ORDER AFTER (DATE)
20.   DUPLICATE COPY NUMBER
21.   LANGUAGE/TRANSLATION AND/OR TRANSLITERATION
22.   GENERAL NOTES

                 (END OF RECORD)
```

to by tag number or by a specified mnemonic code. Often the display will not contain the entire record, but the technician may page either forward or backward in the numbered data elements.

A sample order and claim form is shown in Figure 5. One form will be used for each item purchased or requested for gifts or exchange. This form is outputted in a batch mode on the line printer at the central computing facility. Only one side receives unique data; the back of the form contains a standard group of messages for the source to use. The note area is used to carry specific messages, such as special handling instructions and gift or exchange request statements. The same form can be used for various claim or cancellation requests (by using the note area) if the item is not received in the time prescribed by NAL; e.g., two weeks for domestic orders and four weeks for foreign. The form could be self-sealing. The vendor need only check the appropriate box, fold and seal the form, affix a stamp, and mail the form.

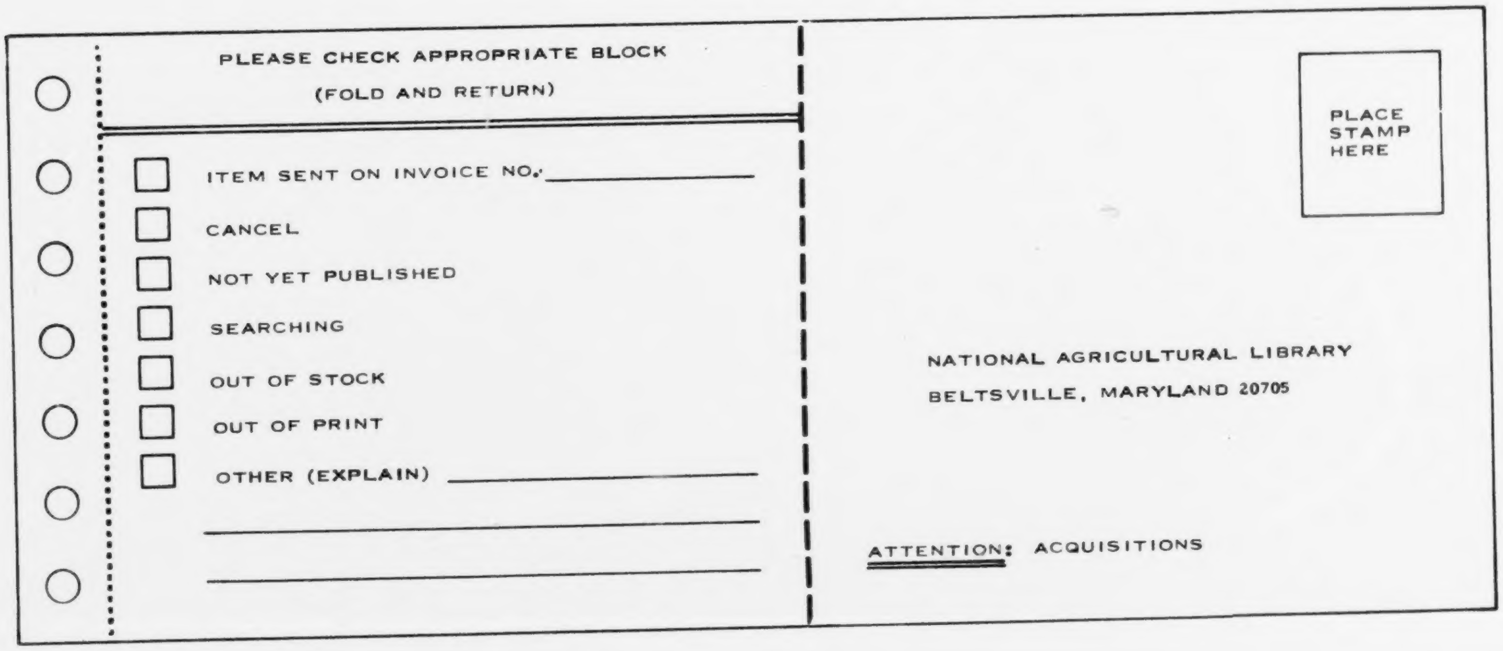
To accomplish the tasks related to the acquisition function, a working staff of 12 is required, as opposed to the staff of 14 required in the present system. The changes in number

FIGURE 5
Order and Claim Form



VENDOR CODE
NUMBER OF COPIES
NATIONAL AGRICULTURAL LIBRARY
ACQUISITIONS DEPT.
DATE ORDERED
CLAIM DATE NO. 1
P.O. NUMBER
P-
CLAIM DATE NO. 2
GIFT REQUEST NO.
G-
EXCHANGE REQUEST NO.
E-
AUTHOR:
TITLE:
PUBLISHER:
DATE:
PRICE:
EDITION:
VOLUME:
CODE NOTES
PLEASE NOTE:
TO:
RETURN WITH ITEM OR AS A REPORT
(NECESSARY TO CLEAR OUR INVOICE RECORDS)
SEE REVERSE

FRONT



PLEASE CHECK APPROPRIATE BLOCK
(FOLD AND RETURN)

☐ ITEM SENT ON INVOICE NO.________________
☐ CANCEL
☐ NOT YET PUBLISHED
☐ SEARCHING
☐ OUT OF STOCK
☐ OUT OF PRINT
☐ OTHER (EXPLAIN) ________________

PLACE STAMP HERE

NATIONAL AGRICULTURAL LIBRARY
BELTSVILLE, MARYLAND 20705

ATTENTION: ACQUISITIONS

BACK

and type of personnel are the result of eliminating the production and filing of multiple order cards (e.g., LF-317) and manual serial issue claiming and of adding descriptive cataloging. The general responsibilities of the staff are:

- Professionals. One supervisor checks problems, approves purchases, reviews in-process records, and is authorized to change information in the permanent data record. Three professionals handle selection.
- Technicians. Five to six technicians are needed to check selected citations against holdings (the total data base), to create and verify order records, to select vendor/source, to check gift items against holdings after selection has been made, and to do preliminary and/or descriptive cataloging on all items. In addition, they receive items, correct preliminary cataloging, and handle misfiled orders.
- Clerks. Three clerks process the items received; i.e., property stamp, affix accession number generated when descriptive cataloging has been completed and add item identification cards. They sort out items readily identifiable as nonordered to be reviewed for selection.

The staff will utilize five remote work stations, each of which will contain a CRT display with a keyboard entry and a label printer. Typewriter outputs will not be provided because real-time hard copy is not necessary to the acquisition function; however, if the need develops, a typewriter terminal may be readily added to any existing work station.

(2) Serial Record and Control

NAL is primarily a serial library. The creation and control of a serial data base is mandatory for the automated system. The sheer bulk of material received each day demands a rapid, economical, and accurate method for identifying issues and recording data. Specifically, the serial record and control functions include receiving, identifying, establishing records, routing, and disposing of all serial issues, as well as claiming missing issues of current serials, renewing subscriptions, and maintaining holdings, records, and files.

The following factors were taken into account in developing an automated scheme for a serial check-in system:

- Approximately 575,000 issues are received each year, resulting in the need to check-in 375,000 issues.
- Approximately 30 percent of these serials are foreign-language publications, which are to be checked-in by a staff member without a translation capability.
- The turnover of check-in personnel precludes prolonged training sessions in the use of an automated system.
- Accurate identification of the serial and its pertinent data elements is of primary importance.

The nucleus of the serial record and control function is a permanent, machine-readable, serial title card. As illustrated in Figure 6, this card provides a graphic presentation for hard-to-identify serials in order to expedite positive identification of the serial title and the data elements pertinent to the automated system. The serial title card has the following characteristics:

- A durable finish, such as laminated plastic, in a machine-readable format
- A size appropriate for ease of handling and inclusion of pictorial representations
- Color coding for alphabet and language distinction
- Space for temporary and permanent notes
- Temporary notes to be added via a computer-printed, self-adhering label or via erasable pen and pencil notations
- Simplicity in format so that only data pertinent to identification (for check-in purposes) are included.

Although all serial title cards are capable of containing pictorial representations of the serial, it is anticipated that only difficult or confusing serial titles will be given pictorial representation. The serial title card illustrated in Figure 7 is typical of the majority of serials received and processed by NAL.

FIGURE 6
Serial Title Card for Pictorial
Representation

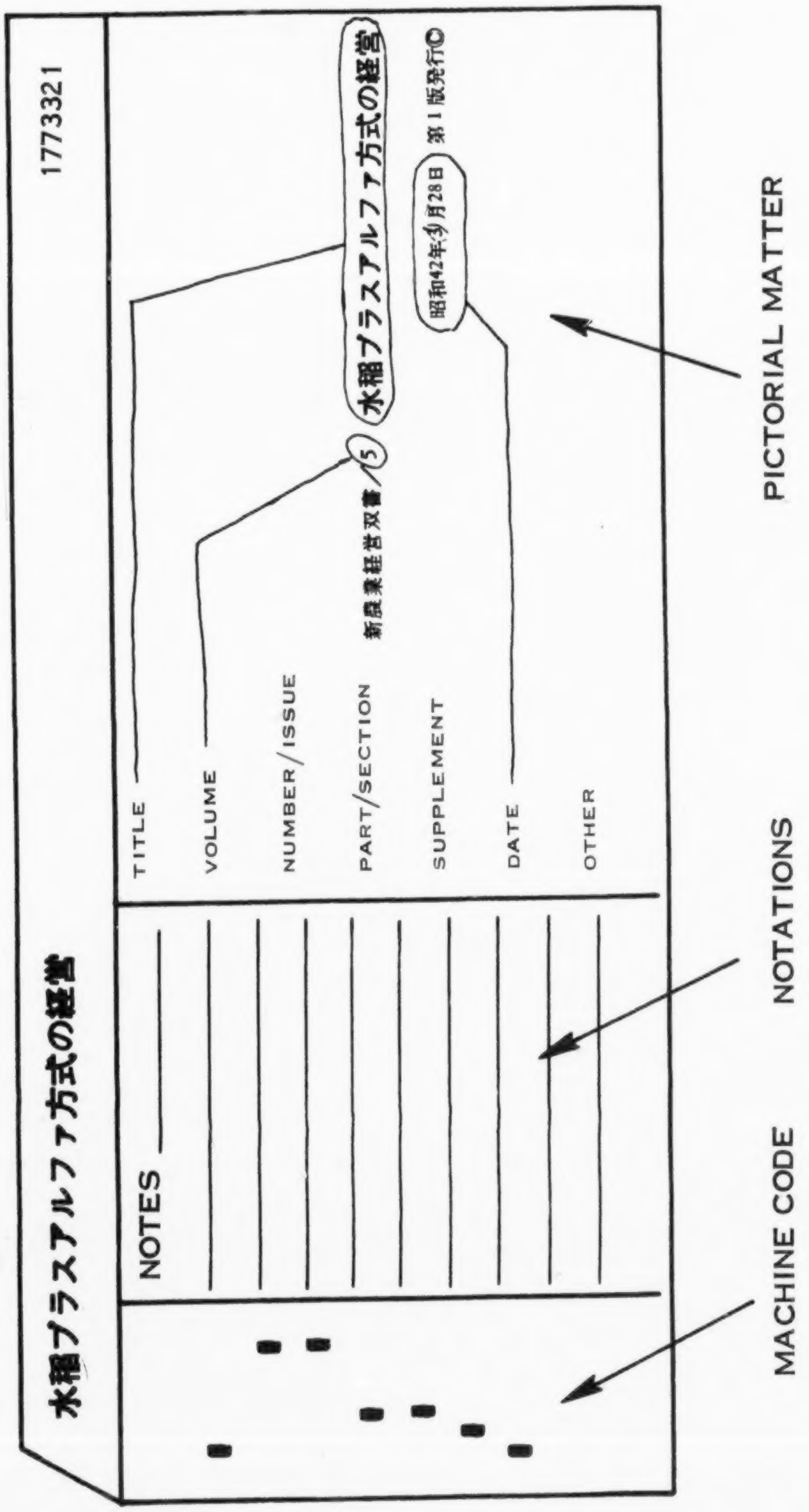
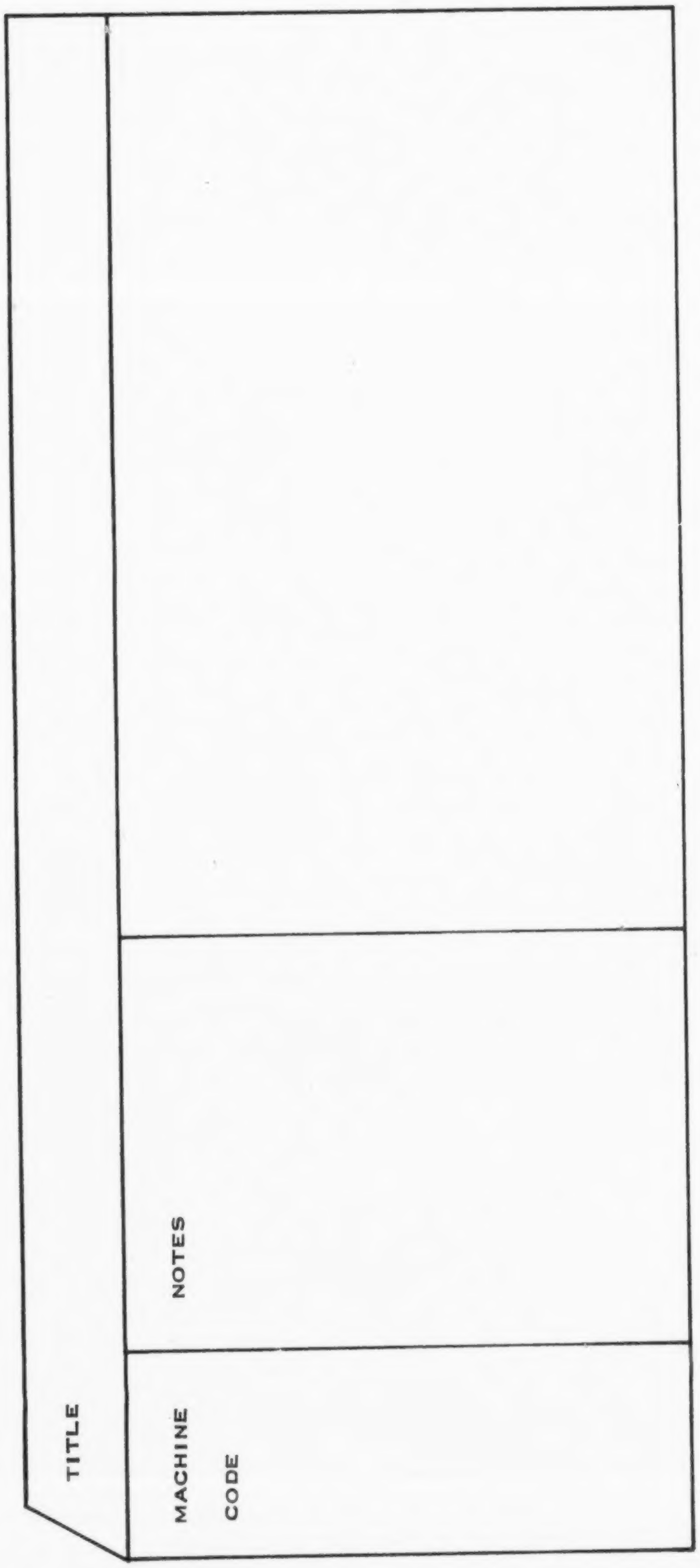

1773321
水稲プラスアルファ方式の経営
NOTES
TITLE
VOLUME
NUMBER/ISSUE
PART/SECTION
SUPPLEMENT
DATE
OTHER
新農業経営双書
5
水稲プラスアルファ方式の経営
昭和42年3月28日
第1版発行
PICTORIAL MATTER
NOTATIONS
MACHINE CODE

FIGURE 7
Typical Serial Title Card


TITLE
NOTES
MACHINE
CODE

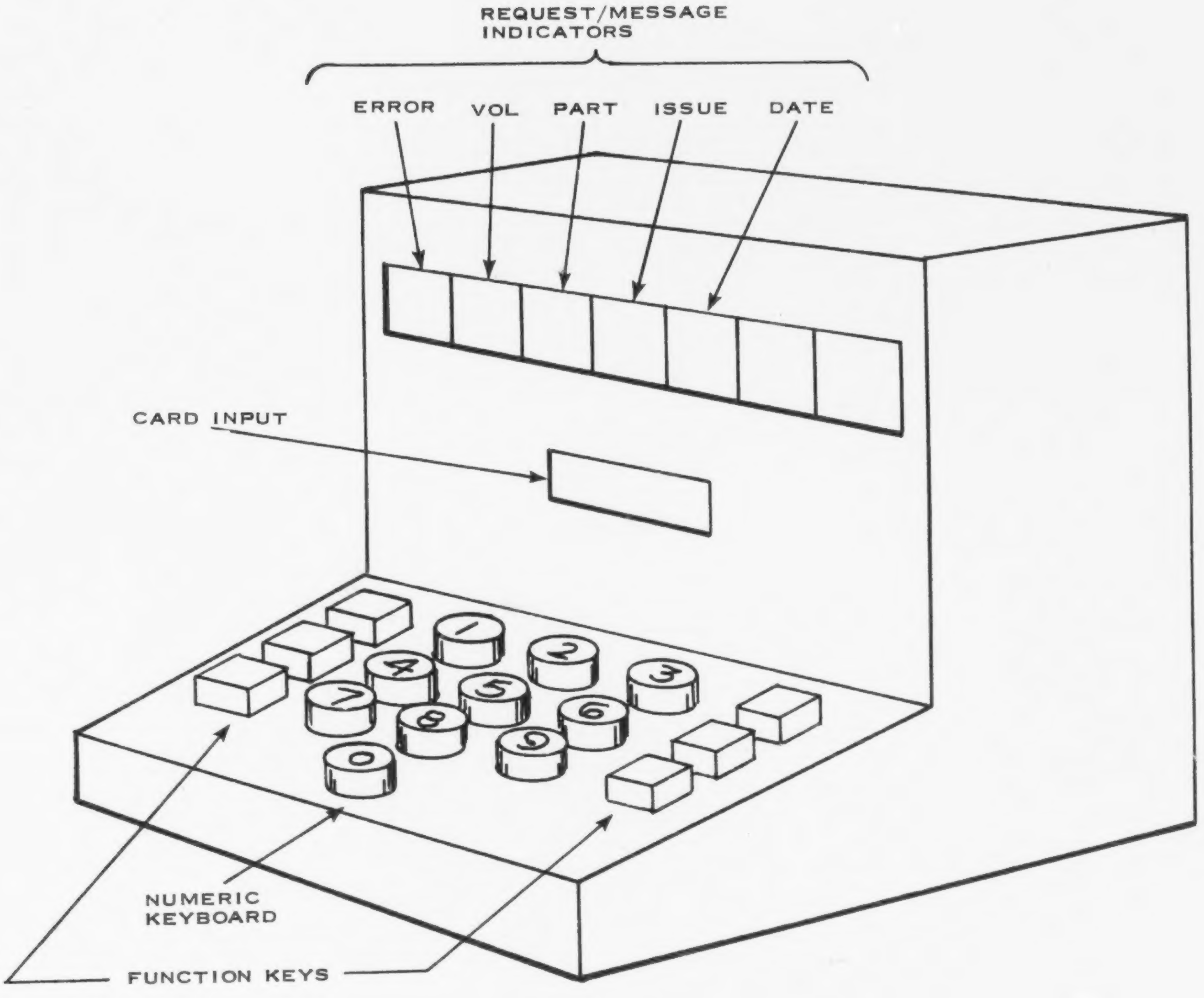
The serial title cards will be filed by the following major classifications:

- Roman alphabet sections divided into individual checker groups such as A through C, D through E, etc.
- Non-Roman title cards further divided into alphabet sections, language groups, countries, etc.

Operation of the system for processing serial issues can be understood by examining the routine flow of the serial from its arrival at NAL to its inclusion in the collection. All serial items are delivered to a specified work area by the mail room. An effort is made to have the source or vendor use a unique address code for ease in identifying ordered and unordered serials. The ordered group is sorted into Roman alphabet and non-Roman alphabet titles. The Roman alphabet titles are sorted to 13 segments of approximately equal volume, and a specific group is made available to a checker who regularly works with that portion of the alphabet.

The checker identifies the title of the item and searches his alphabetic file of serial check-in title cards. When the correct card is found and matched to the item, the card is put into the transactor, which is functionally depicted in Figure 8.

FIGURE 8
Transactor for Serials


REQUEST/MESSAGE INDICATORS
ERROR
VOL
PART
ISSUE
DATE
CARD INPUT
NUMERIC KEYBOARD
FUNCTION KEYS

Through a series of panel lights, the system requests information on the highest breakdown of holdings data to be stored. The checker keys in this information. Check-in of multiple copies is straightforward and requires no special recognition by the checker. He merely inputs each serial issue as received, and the automated system notes that the _nth_ copy of _m_ copies has been received. Only if more than _m_ copies are received is it necessary for the machine to alert the checker.

If the input information is in agreement with the data stored in the system (e.g., if the volume number is the one anticipated), the system continues its requests until the required data for the specific serial issues has been obtained.

After the system recognizes that the complete data have been inputted, the checker initiates a transfer of this working data to the intermediate data base; and the system automatically assigns and prints out an accession number.

Tables 4, 5, and 6 illustrate the scheme for assigning accession numbers to specific categories of items received for addition to the collection. This accession number is unique for each individual title. Thus, the numbering scheme distinguishes:

Table 4
Accession Number Matrix for Monographs

ITEM	NUMBER ARRANGEMENT			
MONOGRAPHS	ASSIGNED ACCESSION NUMBER	ACCESSION NUMBER SEEN ON THE SHELF (SHELF NUMBER)	ACCESSION NUMBER USED FOR CHARGE-OUT PURPOSES (CHARGE NUMBER)	NOTES
TITLE (UNIQUE)	1773241	1773241	1773241	A UNIQUE ACCESSION NUMBER
DUPLICATE COPY (S)	1773241-1 1773241-2	1773241-1 1773241-2	1773241-1 1773241-2	AN ACCESSION NUMBER WITH A DASH NUMBER TO INDICATE NUMBER OF COPIES
NEW EDITION (ETC.)	1811364	1811364	1811364	A NEW (DIFFERENT) ACCESSION NUMBER, BUT LINKED INTERNALLY TO PRECEDING EDITION (S).

Table 5
Accession Number Matrix for Serials To Be Bound

ITEM	NUMBER ARRANGEMEN							
SERIALS (TO BE BOUND)	NUMBER ASSIGNED TO A SERIAL TITLE (ACCESSION NUMBER)	NUMBER FOR INDIVIDUAL PART OF A SERIAL TITLE (PART NUMBER)		NUMBER SEEN ON A BOUND VOLUME (BOUND NUMBER)		SHELF NUMBER		SE UNI NU
						BEFORE BINDING (PART)	AFTER BIND (VOLUMES)	
SERIAL TITLE (UNIQUE)	0127361	FIRST PART	0127361 −1	FIRST VOLUME	0127361 AA	0127361 −1	0127361 AA	
		SECOND PART	0127361 −2	SECOND VOLUME	0127361 AB	0127361 −2	0127361 AB	
DUPLICATE COPY (S)	0127361 −0 −1	FIRST COPY OF FIRST PART	0127361 −1 −1	FIRST COPY FIRST VOLUME	0127361 AA−1	0127361 −1 −1	0127361 AA−1	
		FIRST COPY OF SECOND PART	0127361 −2 −1	FIRST COPY SECOND VOLUME	0127361 AB−1	0127361 −2 −1	0127361 AB−1	

Table 5
Accession Number Matrix for Serials To Be Bound

NUMBER ARRANGEMENT					
SEEN UND VOLUME NUMBER)	SHELF NUMBER		NUMBERS USED FOR CHARGE OUT		NOTES
	BEFORE BINDING (PART)	AFTER BINDING (VOLUMES)	BEFORE BINDING (PART)	AFTER BINDING (VOLUMES)	
0127361 AA	0127361 −1	0127361 AA	0127361 −1	0127361 AA	1) "0" BEFORE NUMBER INDICATES A SERIAL TITLE
0127361 AB	0127361 −2	0127361 AB	0127361 −2	0127361 AB	2) NUMBER ADDED AFTER DASH (−) INDICATES SUCCESSIVE PART OF A GIVEN TITLE
					3) LETTERS ADDED INDICATE SUCCESSIVE BOUND VOLUMES OF A GIVEN TITLE
0127361 AA−1	0127361 −1 −1	0127361 AA−1	0127361 −1 −1	0127361 AA−1	1) DUPLICATE COPIES OF SAME PART OF GIVEN SERIAL TITLE INDICATED BY A SECOND NUMERAL ADDED AFTER A SECOND DASH (−)
0127361 AB−1	0127361 −2 −1	0127361 AB−1	0127361 −2 −1	0127361 AB−1	2) DUPLICATE COPIES OF BOUND VOLUMES OF A GIVEN SERIAL TITLE ARE INDICATED BY A DASH (−) AND A NUMBER AFTER THE LETTER DESIGNATION

Table 6

Accession Number Matrix
for Serials Not To Be Bound

ITEM	NUMBER ARRANGEMENT					
SERIALS (NOT TO BE BOUND)	NUMBER ASSIGNED TO A SERIAL TITLE (ACCESSION NUMBER)	NUMBER FOR INDIVIDUAL PART OF A SERIAL TITLE (PART NUMBER)		SHELF NUMBERS	NUMBER USED FOR CHARGE OUT	NOTES
SERIAL TITLE (UNIQUE)	0132244	FIRST PART	0132244 –1	0132244 –1	0132244 –1	1) "0" BEFORE NUMBER INDICATES A SERIAL TITLE 2) NUMBER ADDED AFTER A DASH (–) INDICATES SUCCESSIVE PART OF A GIVEN TITLE
		SECOND PART	0132244 –2	0132244 –2	0132244	
DUPLICATE COPIES	0132244 –0 –1	FIRST COPY OF FIRST PART	0132244 –1 –1	0132244 –1 –1	0132244 –1 –1	DUPLICATE COPIES OF SAME PART OF GIVEN SERIAL TITLE INDICATED BY A SECOND NUMERAL ADDED AFTER A SECOND DASH (–)
		FIRST COPY OF SECOND PART	0132244 –2 –1	0132244 –2 –1	0132244 –2 –1	

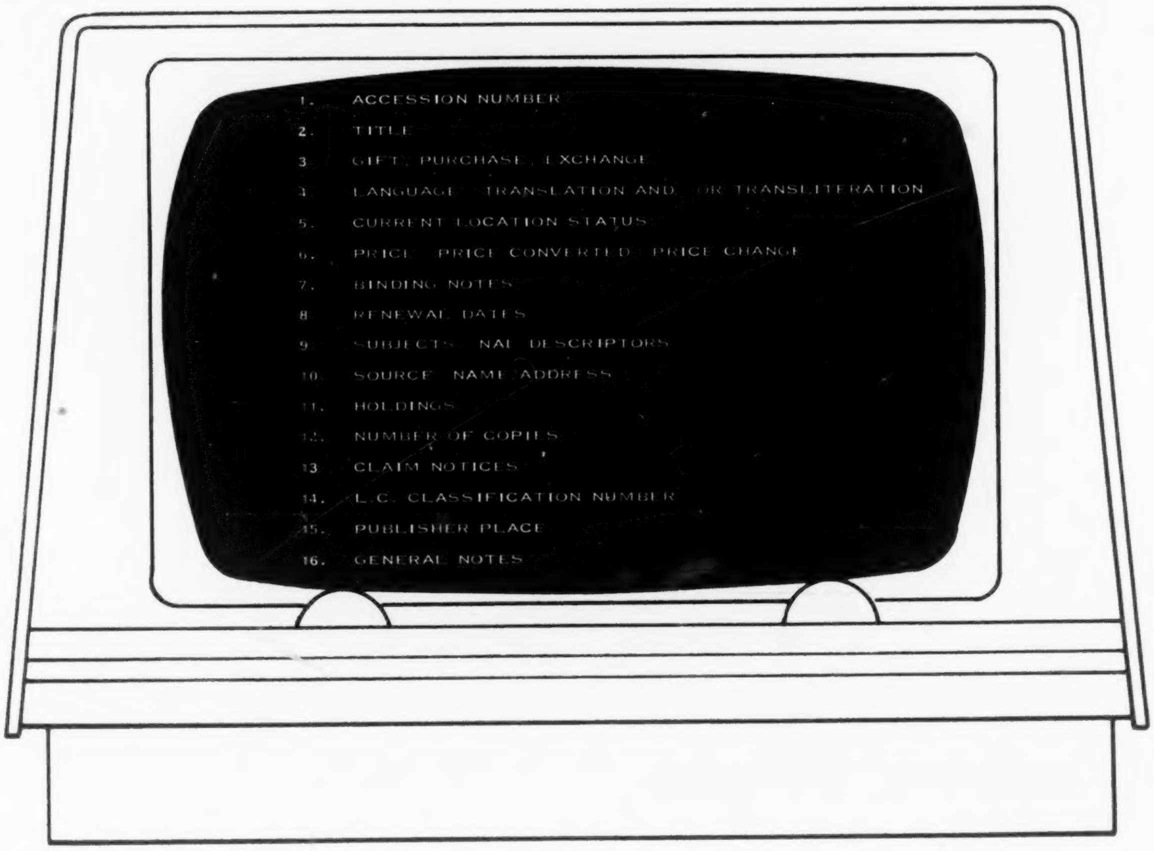
- Monographs
- Serial parts to be bound later
- Serial parts that are not to be bound
- Bound serial volumes
- Multiple copies of any of these.

At the same time that the system assigns and prints the accession number, the label printer prepares a routing sticker (if necessary) that contains a sequence of codes representing different internal locations at NAL for each copy of the multiple copies of a single issue. The checker affixes a label to each issue and returns the title card to its slot.

Any item not identified or not routinely processable is given to a special checker with access to a CRT terminal. The technician will utilize a variety of the standard output formats described in Section 4 of this chapter as well as the special format shown in Figure 9. In some cases, this action generates the information required to change a serial record (e.g., a title change). The overall check-in flow is shown in Figure 10.

Because of the amorphous nature of serials, there are some functions that must be performed by a special checker.

FIGURE 9
Special Serials Check-In Display


1. ACCESSION NUMBER
2. TITLE
3. GIFT, PURCHASE, EXCHANGE
4. LANGUAGE TRANSLATION AND OR TRANSLITERATION
5. CURRENT LOCATION STATUS
6. PRICE PRICE CONVERTED PRICE CHANGE
7. BINDING NOTES
8. RENEWAL DATES
9. SUBJECTS NAL DESCRIPTORS
10. SOURCE NAME ADDRESS
11. HOLDINGS
12. NUMBER OF COPIES
13. CLAIM NOTICES
14. L.C. CLASSIFICATION NUMBER
15. PUBLISHER PLACE
16. GENERAL NOTES

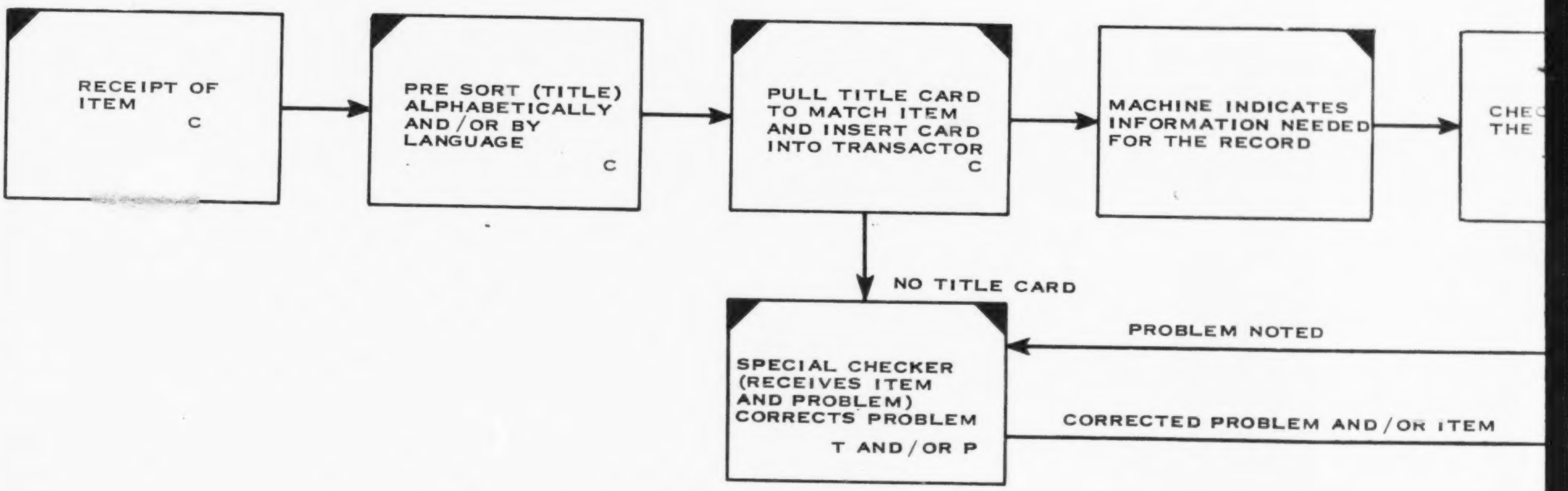
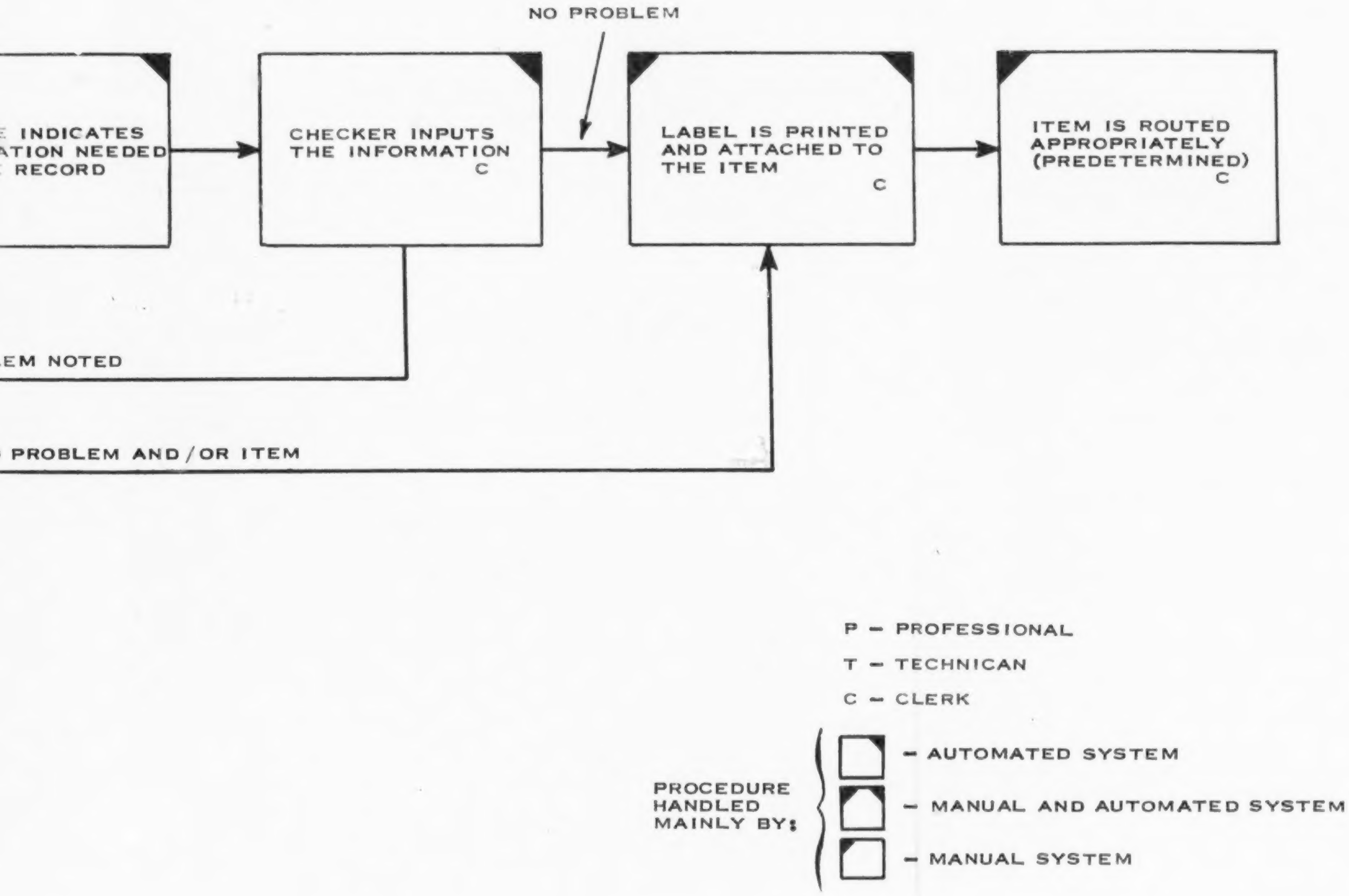

RECEIPT OF ITEM
C
PRE SORT (TITLE) ALPHABETICALLY AND/OR BY LANGUAGE
C
PULL TITLE CARD TO MATCH ITEM AND INSERT CARD INTO TRANSACTOR
C
MACHINE INDICATES INFORMATION NEEDED FOR THE RECORD
CHEC
THE
NO TITLE CARD
SPECIAL CHECKER (RECEIVES ITEM AND PROBLEM) CORRECTS PROBLEM
T AND/OR P
PROBLEM NOTED
CORRECTED PROBLEM AND/OR ITEM

FIGURE 10
Routine Serial Check-In


E INDICATES
ATION NEEDED
RECORD
CHECKER INPUTS THE INFORMATION C
NO PROBLEM
LABEL IS PRINTED AND ATTACHED TO THE ITEM C
ITEM IS ROUTED APPROPRIATELY (PREDETERMINED) C
EM NOTED
PROBLEM AND/OR ITEM
P - PROFESSIONAL
T - TECHNICAN
C - CLERK
PROCEDURE HANDLED MAINLY BY:
- AUTOMATED SYSTEM
- MANUAL AND AUTOMATED SYSTEM
- MANUAL SYSTEM

These functions include:

- Selection of items from the displayed claim-alert list based upon a judgment of the necessity for each claim
- Correlation of binding requests with the physical material to be bound to ensure quality control.

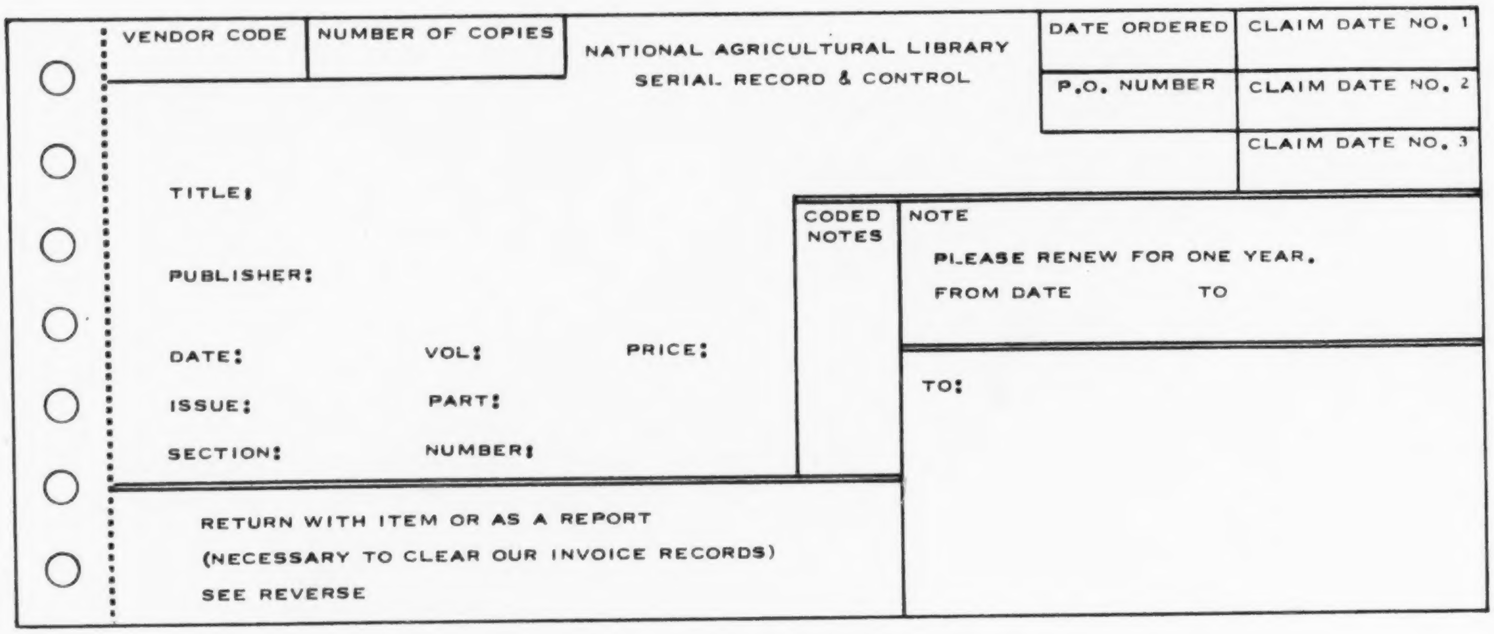
Samples of suggested forms for serial renewal, serial claim, and binding request are shown in Figures 11 and 12.

The personnel necessary to perform the tasks in the serial record and control functions are:

- Professionals. A supervisor is responsible for administration, training, and quality control of the serial file.
- Technicians. Three special checkers handle difficult issues, verify claims, check binding requests, identify changes (e.g., serial title changes and discontinuations), and notify cataloging of them.
- Clerks. Fourteen routine checkers process incoming serials; one clerk does general typing and other clerical duties, and two sort mail.

The number of checkers was determined by estimating the workload in numbers of serial issues and the average time for the check-in operation.

FIGURE 11
Renewal and Claim Form



VENDOR CODE

NUMBER OF COPIES

NATIONAL AGRICULTURAL LIBRARY
SERIAL RECORD & CONTROL

DATE ORDERED

CLAIM DATE NO. 1

P.O. NUMBER

CLAIM DATE NO. 2

CLAIM DATE NO. 3

TITLE:

PUBLISHER:

DATE: VOL: PRICE:

ISSUE: PART:

SECTION: NUMBER:

CODED NOTES

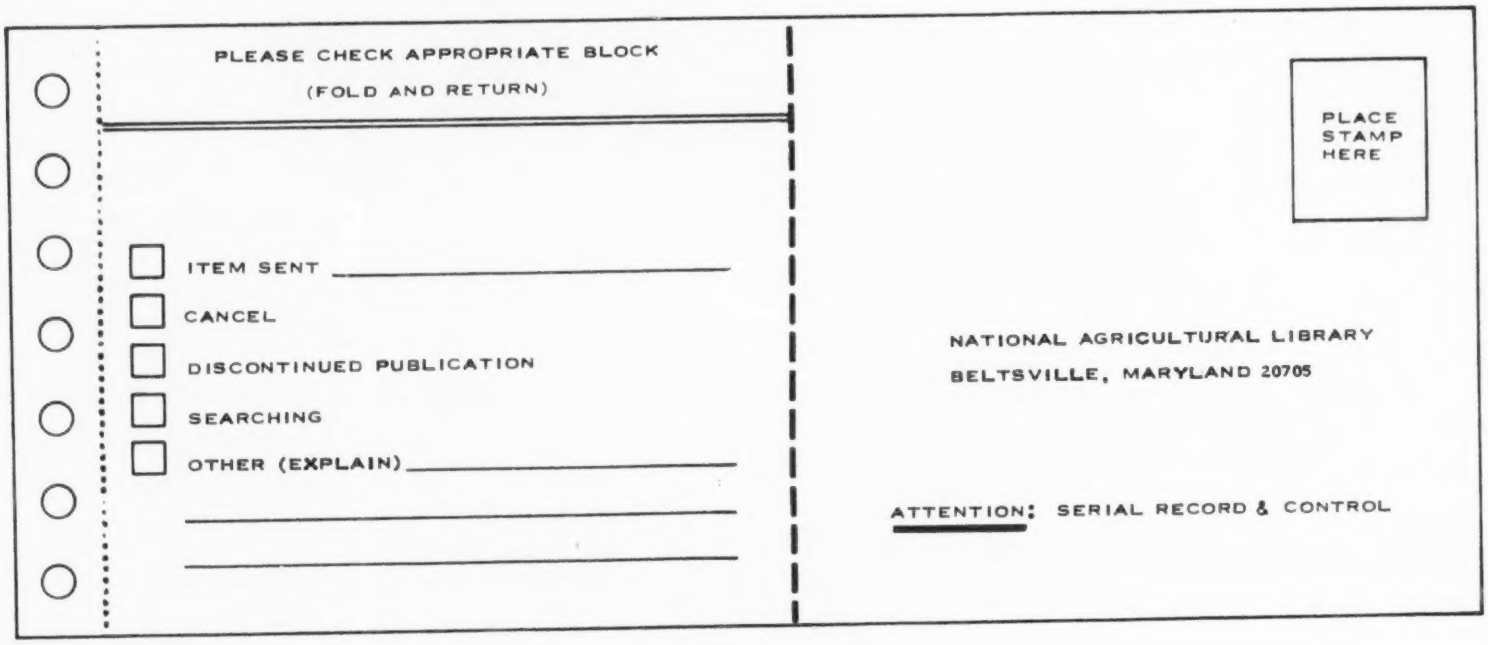
NOTE

PLEASE RENEW FOR ONE YEAR.
FROM DATE TO

TO:

RETURN WITH ITEM OR AS A REPORT
(NECESSARY TO CLEAR OUR INVOICE RECORDS)
SEE REVERSE

FRONT



PLEASE CHECK APPROPRIATE BLOCK
(FOLD AND RETURN)

☐ ITEM SENT ____________________

☐ CANCEL

☐ DISCONTINUED PUBLICATION

☐ SEARCHING

☐ OTHER (EXPLAIN) ____________________

____

____

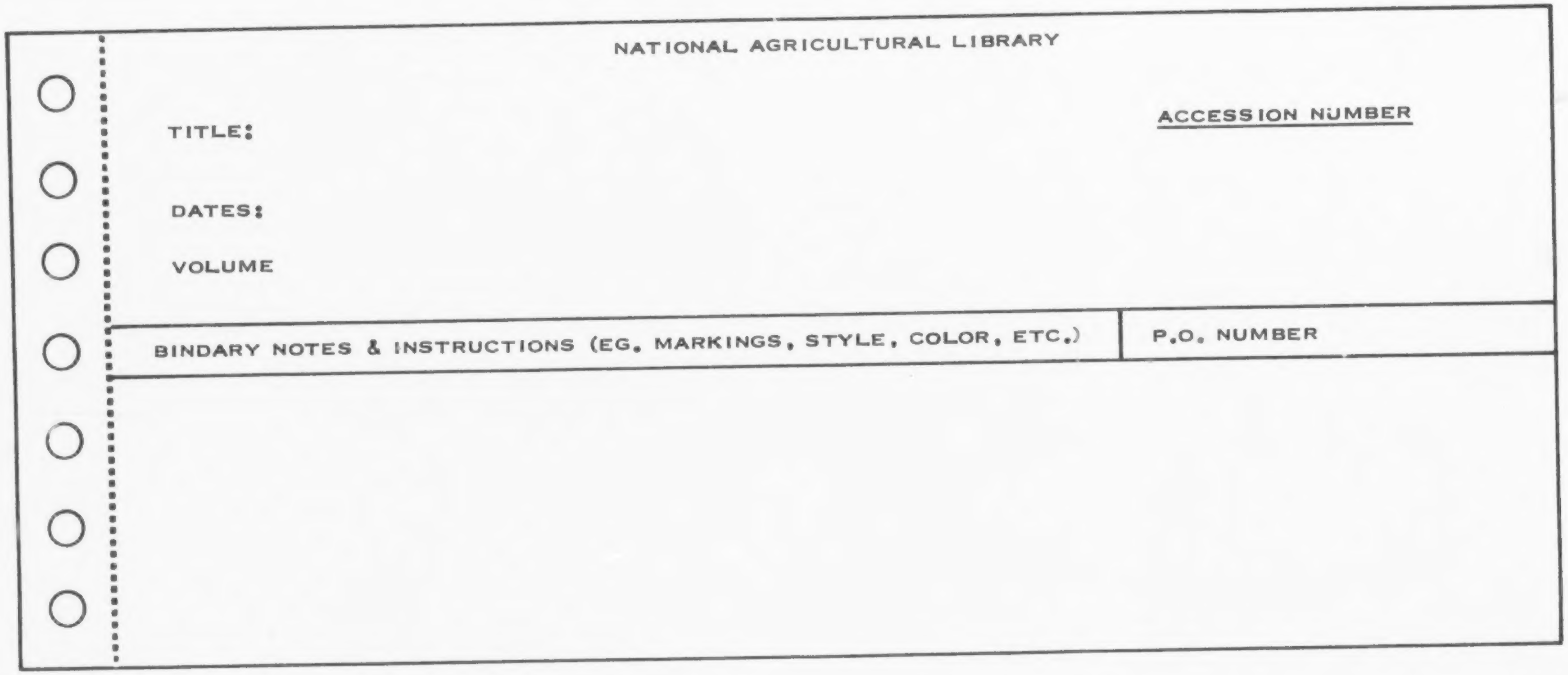
PLACE
STAMP
HERE

NATIONAL AGRICULTURAL LIBRARY
BELTSVILLE, MARYLAND 20705

ATTENTION: SERIAL RECORD & CONTROL

BACK

FIGURE 12
Binding Request



NATIONAL AGRICULTURAL LIBRARY

TITLE:

DATES:

VOLUME

ACCESSION NUMBER

BINDARY NOTES & INSTRUCTIONS (EG. MARKINGS, STYLE, COLOR, ETC.)

P.O. NUMBER

A variety of equipment will be used by the serial record and control functions. When fully implemented, the check-in operation will utilize 14 transactors, each of which will be used in conjunction with a label printer and three CRT/keyboard units. The latter will be used by the technicians and the supervisor to solve special problems that require a dialogue with the automated system.

(3) Cataloging and Quality Control of Records

The cataloging function includes assigning Library of Congress classification numbers, NAL subject terms/descriptors, creating and maintaining authorities, completing records initiated by the acquisition function, and reviewing changes in records generated throughout the system.

The flow of typical activities, shown in Figure 13, in the cataloging function begins when the acquisition function has been completed.

The cataloger enters the automated system, via the keyboard associated with the CRT, by using the accession number. The system responds by displaying the item record on the CRT screen. The cataloger reviews the record, checks for any notes

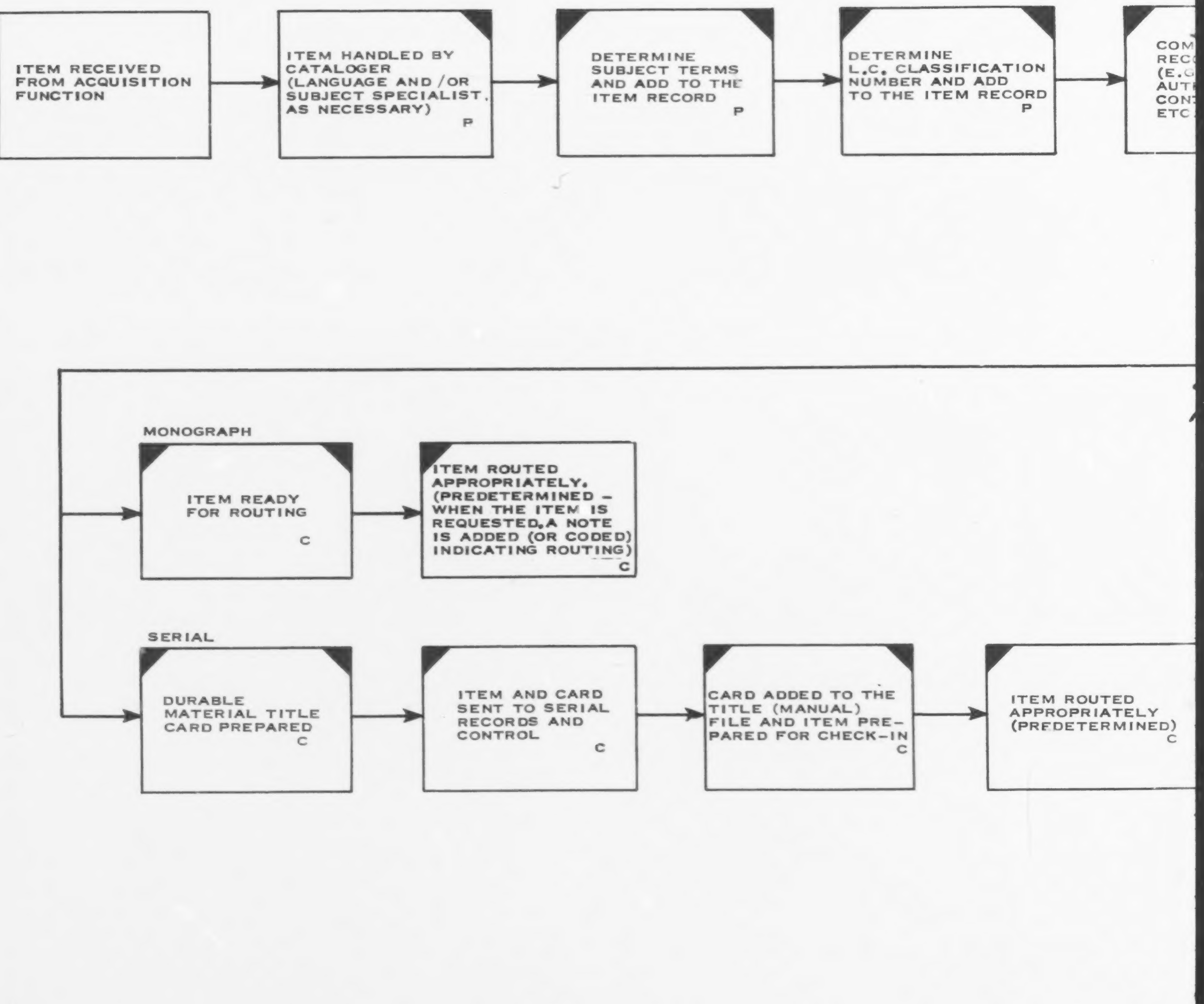
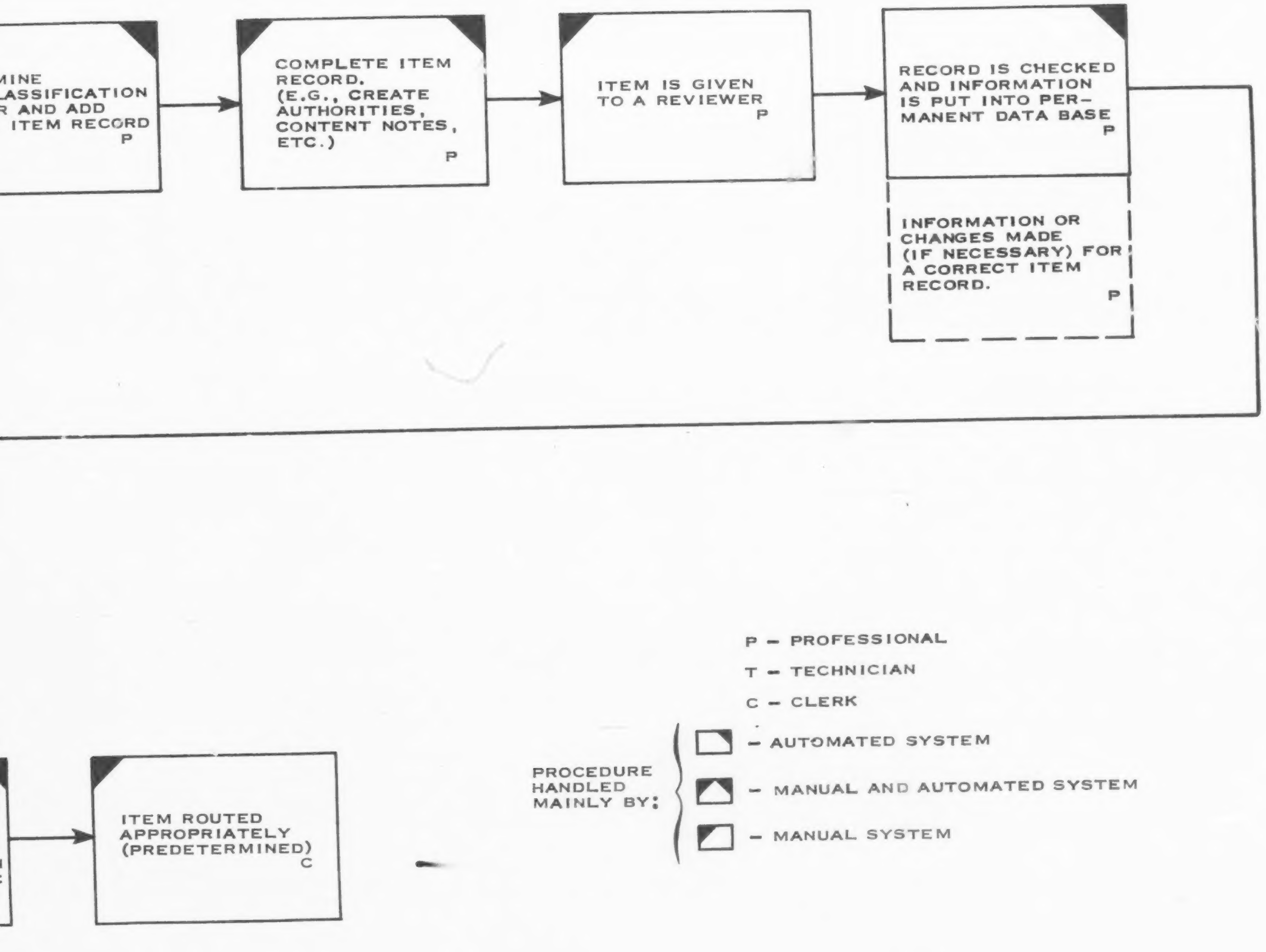

ITEM RECEIVED FROM ACQUISITION FUNCTION
ITEM HANDLED BY CATALOGER (LANGUAGE AND /OR SUBJECT SPECIALIST, AS NECESSARY) P
DETERMINE SUBJECT TERMS AND ADD TO THE ITEM RECORD P
DETERMINE L.C. CLASSIFICATION NUMBER AND ADD TO THE ITEM RECORD P
COM
REC
(E.G
AUT
CON
ETC
MONOGRAPH
ITEM READY FOR ROUTING C
ITEM ROUTED APPROPRIATELY. (PREDETERMINED – WHEN THE ITEM IS REQUESTED, A NOTE IS ADDED (OR CODED) INDICATING ROUTING) C
SERIAL
DURABLE MATERIAL TITLE CARD PREPARED C
ITEM AND CARD SENT TO SERIAL RECORDS AND CONTROL C
CARD ADDED TO THE TITLE (MANUAL) FILE AND ITEM PREPARED FOR CHECK-IN C
ITEM ROUTED APPROPRIATELY (PREDETERMINED) C

FIGURE 13
Cataloging Flow


MINE
LASSIFICATION
R AND ADD
ITEM RECORD
P
COMPLETE ITEM RECORD. (E.G., CREATE AUTHORITIES, CONTENT NOTES, ETC.)
P
ITEM IS GIVEN TO A REVIEWER
P
RECORD IS CHECKED AND INFORMATION IS PUT INTO PERMANENT DATA BASE
P
INFORMATION OR CHANGES MADE (IF NECESSARY) FOR A CORRECT ITEM RECORD.
P
ITEM ROUTED APPROPRIATELY (PREDETERMINED)
C
P – PROFESSIONAL
T – TECHNICIAN
C – CLERK
PROCEDURE HANDLED MAINLY BY:
– AUTOMATED SYSTEM
– MANUAL AND AUTOMATED SYSTEM
– MANUAL SYSTEM

that may have been added for his benefit (e.g., create an author authority), and begins the manual operation of assigning a Library of Congress classification number (if not already in the item record).

The selection of subject terms is accomplished by paging, on the CRT, through the structured machine-readable subject terms until the correct one is found. The cataloger can add the new information to the item record as each decision is made, or he can accumulate data and enter all of them at one time. When the cataloger determines that the item record has been completed, he transfers it to the intermediate data base for final review. The final review checker ensures the accuracy of the record and its compatibility with various standards, including MARC II. After the final review checker approves the record, he initiates its transfer to the permanent data base.

The procedure for changing a serial record is essentially the same as that for a new title. When a change is noted, either a manual note or a temporary record in the intermediate data base is made. The manual form is used when only the existence of a change is to be noted. When the new data can actually be provided, a new record is created in the intermediate data base.

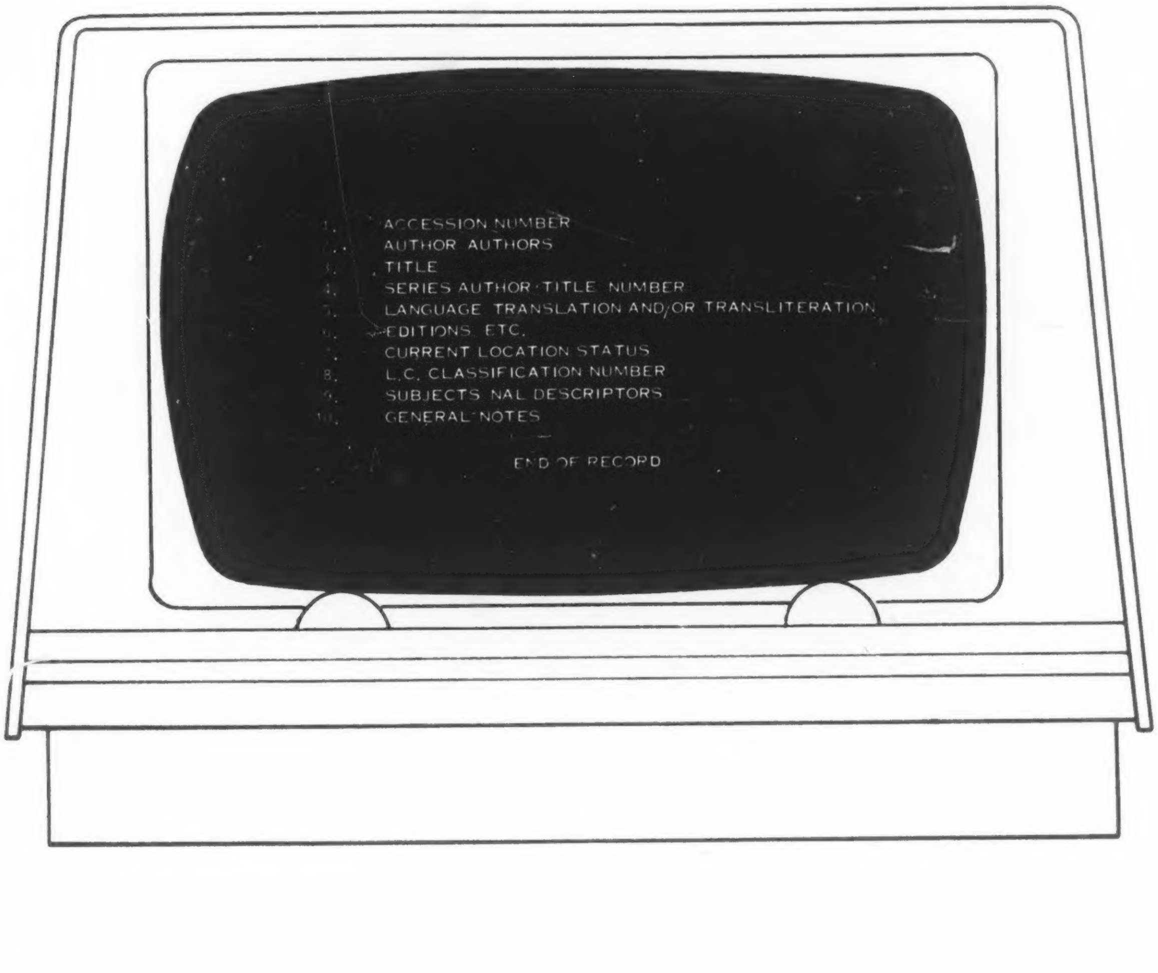
These serial changes are handled either by the final review checkers or by a special cataloger. Three choices of action are open for modifying a serial record:

1. If the change is substantial, a new record is created with a new accession number. The old record is left intact except for the addition of a link to the new record(s).
2. If the change is minor but the old data must be preserved, the old data are replaced by the new; and a note is added that includes the old data and the effective dates.
3. If the change is insignificant and no machine-readable record need be preserved, the old data are simply replaced with the new. (If desired, hard copy can be outputted for the archives.)

The cataloging function will utilize the many CRT formats available in the system. One particularly suited to this function is shown in Figure 14. There are no special forms outputted by the automated system that are originated in the cataloging function.

The professional staff performing the cataloging routine will be essentially the same for the automated system as for the current manual system, but the clerical staff will be greatly reduced because no catalog cards will be typed, sorted, or filed.

FIGURE 14
CRT Display for Cataloging



```
1.     ACCESSION NUMBER
2.     AUTHOR AUTHORS
3.     TITLE
4.     SERIES AUTHOR TITLE NUMBER
5.     LANGUAGE TRANSLATION AND/OR TRANSLITERATION
6.     EDITIONS ETC.
7.     CURRENT LOCATION STATUS
8.     L.C. CLASSIFICATION NUMBER
9.     SUBJECTS NAL DESCRIPTORS
10.    GENERAL NOTES

                 END OF RECORD
```

- Professionals. One supervisor acts as cataloger, checker, and trainer. Two final review checkers check records before they are inputted into the permanent data base and also can change information in the data base. Four catalogers complete item records by assigning subject terms and Library of Congress classification numbers and adding any notes (e.g., contents).

- Clerks. Two clerks perform any additional processing deemed necessary as well as general errands and typing.

Six CRT/keyboards will be the input/output devices used by the catalogers and final review checkers. Thus, one CRT will be available for the use of each cataloger. Typewriter terminals for hard-copy output would also be desirable; such terminals would avoid on-line tie-up and would provide a record for detailed study.

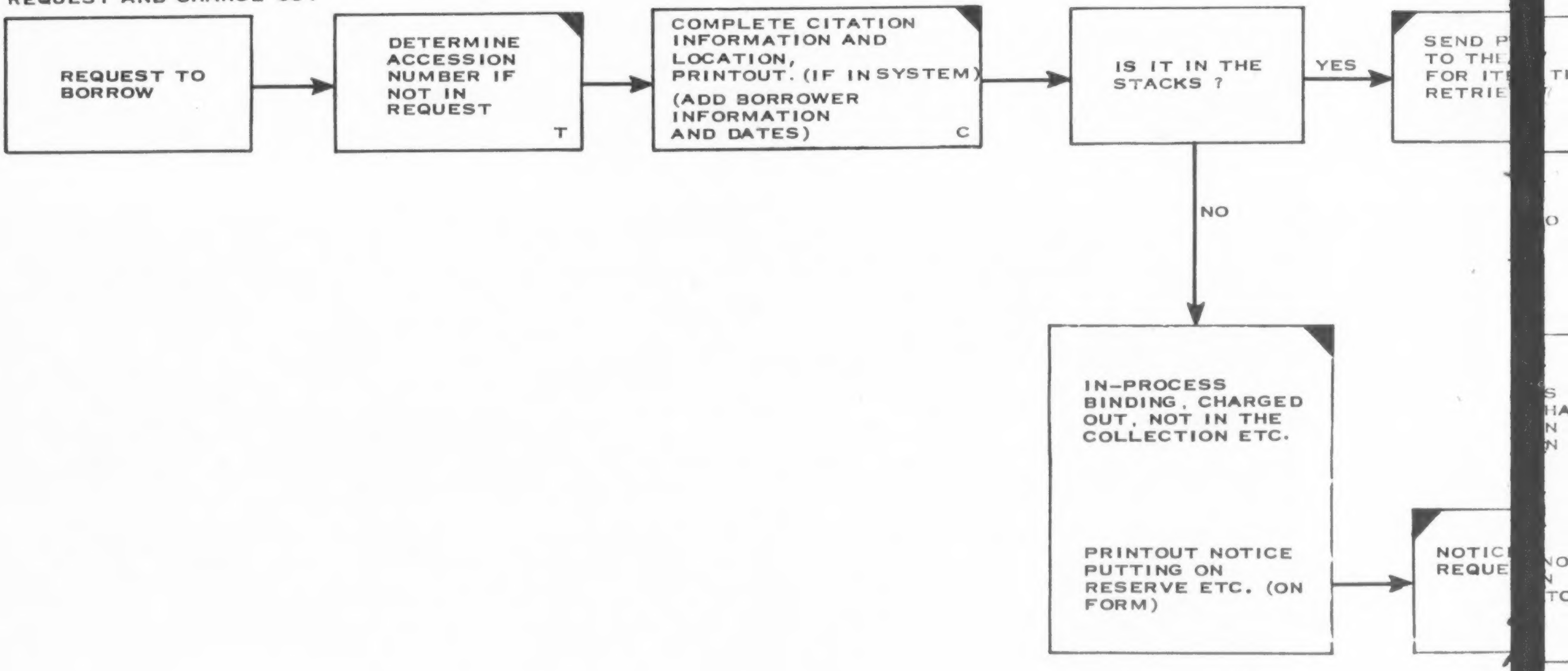
(4) Circulation Control

The circulation control function is primarily to maintain the inventory control system for NAL. This encompasses both the physical handling and preservation of the items and the keeping of records that detail the current status of each item. The automated system will provide dynamic location-and-status information for all circulation operations.(10) The movement of every item in the permanent NAL collection will be noted and controlled by the circulation function.

Several operations must be performed in circulation control, the most basic of which are the checkout and check-in of an item. As shown in Figure 15, the process begins with a request. If this request is in the form of an accession number, a clerk inputs the accession number on a typewriter; and the system responds with a location report that consists of author, title, and physical location. If the request is by title or author/title, a technician uses a CRT/keyboard to search the holdings data base and determines the accession number and location if the item is in the collection. When the request is too general or too vague for handling, it is sent to a reference librarian for clarification and for appropriate accession number(s).

In either case, the accession number is given to a clerk who obtains a location report from the system through his remote typewriter. If the item is on the shelf, a hard-copy report, outputted from the automated system is given to a stack boy who retrieves the item. This report, shown in Figure 16, is returned with the item the stack boy retrieves from the shelves. If the item is not on the shelf, the system requests the user's code. If it is a new user, the address information is inputted at this time. When the user's code is inputted together with a

REQUEST AND CHARGE OUT


REQUEST TO BORROW
DETERMINE ACCESSION NUMBER IF NOT IN REQUEST
T
COMPLETE CITATION INFORMATION AND LOCATION, PRINTOUT. (IF IN SYSTEM)
(ADD BORROWER INFORMATION AND DATES)
C
IS IT IN THE STACKS ?
YES
NO
SEND P
TO THE
FOR ITE
RETRIE
IN-PROCESS BINDING, CHARGED OUT, NOT IN THE COLLECTION ETC.
PRINTOUT NOTICE PUTTING ON RESERVE ETC. (ON FORM)
NOTIC
REQUE

ITEM
RETURN

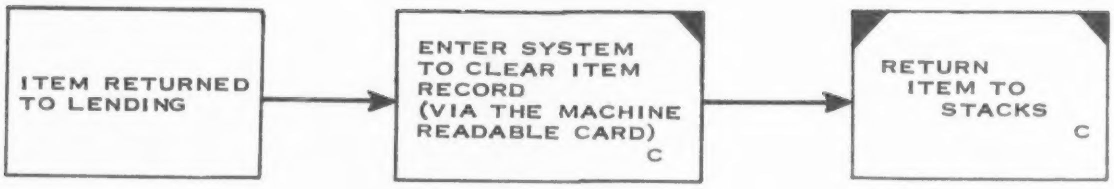
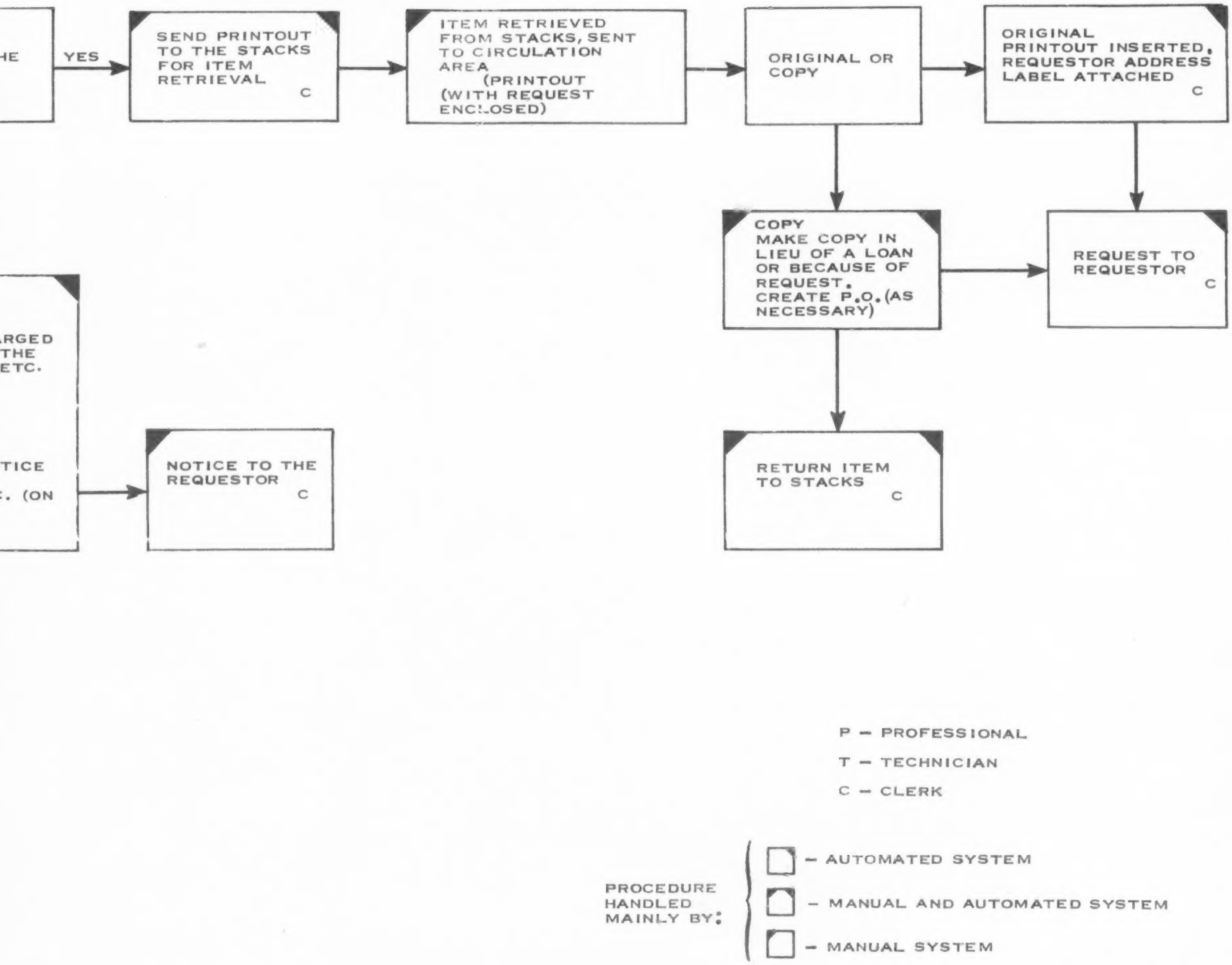
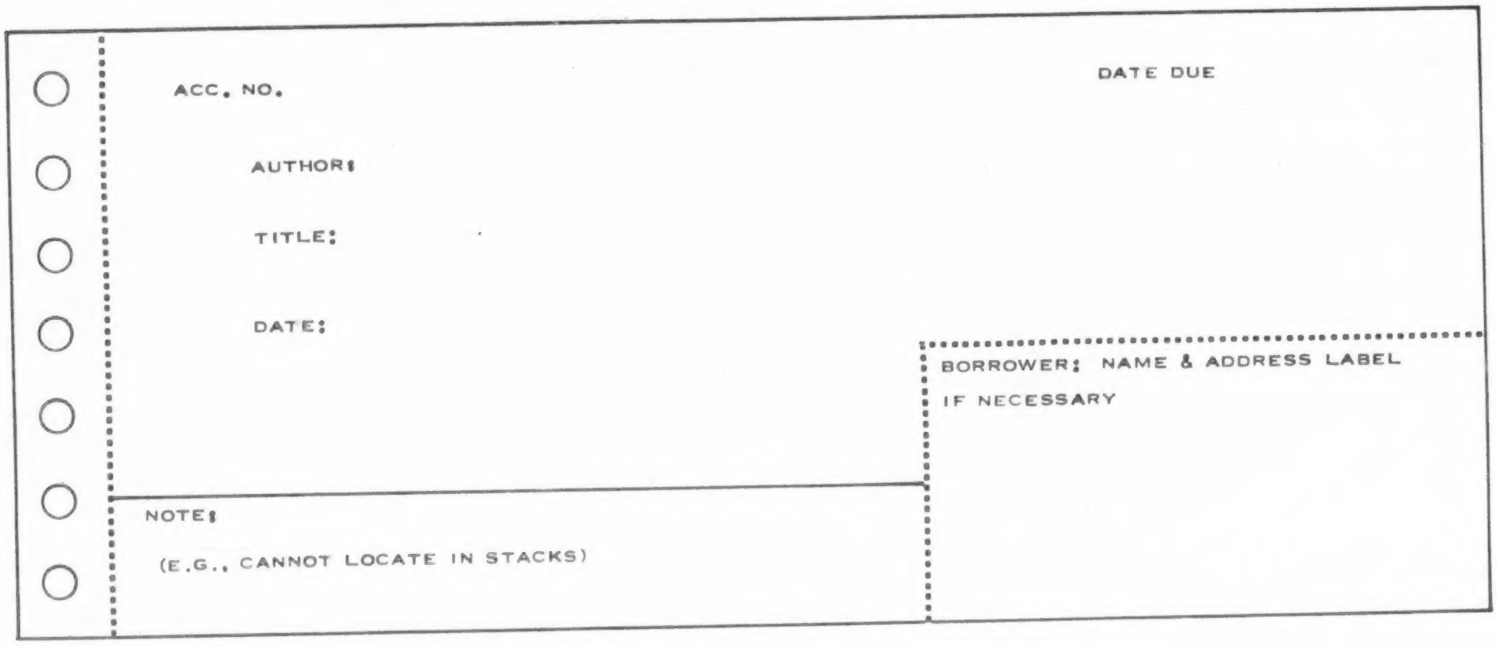

ITEM RETURNED TO LENDING
ENTER SYSTEM TO CLEAR ITEM RECORD (VIA THE MACHINE READABLE CARD)
C
RETURN ITEM TO STACKS
C

FIGURE 15
Circulation Flow Chart


HE
YES
SEND PRINTOUT TO THE STACKS FOR ITEM RETRIEVAL C
ITEM RETRIEVED FROM STACKS, SENT TO CIRCULATION AREA (PRINTOUT (WITH REQUEST ENCLOSED)
ORIGINAL OR COPY
ORIGINAL PRINTOUT INSERTED, REQUESTOR ADDRESS LABEL ATTACHED C
COPY MAKE COPY IN LIEU OF A LOAN OR BECAUSE OF REQUEST. CREATE P.O. (AS NECESSARY)
REQUEST TO REQUESTOR C
RGED
THE
ETC.
TICE
. (ON
NOTICE TO THE REQUESTOR C
RETURN ITEM TO STACKS C
P – PROFESSIONAL
T – TECHNICIAN
C – CLERK
PROCEDURE HANDLED MAINLY BY:
– AUTOMATED SYSTEM
– MANUAL AND AUTOMATED SYSTEM
– MANUAL SYSTEM

reserve notice, the system produces a form, shown in Figure 17, in a batch mode at the central facility for mailing to the requestor. The machine adds the name of the requestor so that the form may be directed to him when it is returned.



ACC. NO.

DATE DUE

AUTHOR:

TITLE:

DATE:

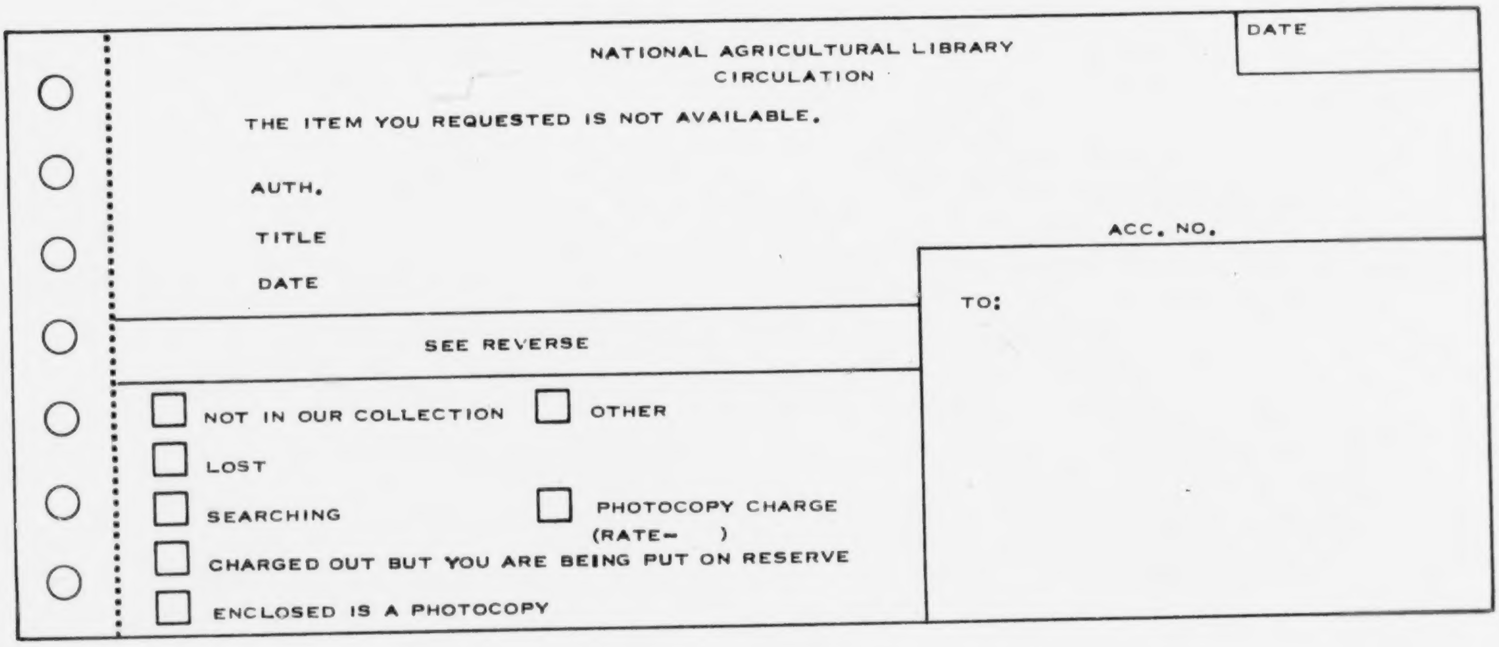
BORROWER: NAME & ADDRESS LABEL
IF NECESSARY

NOTE:
(E.G., CANNOT LOCATE IN STACKS)

FIGURE 16
Report for Shelf Retrieval

Overdue notices are made up automatically on a batch basis and are addressed for mailing on the form shown in Figure 18. If there is no response from the borrower after a fixed interval of time or after a fixed number of notices, the pertinent data are outputted in a list for special action (e.g.,

FIGURE 17
Status Report Form



DATE

NATIONAL AGRICULTURAL LIBRARY
CIRCULATION

THE ITEM YOU REQUESTED IS NOT AVAILABLE.

AUTH.

TITLE

DATE

ACC. NO.

TO:

SEE REVERSE

☐ NOT IN OUR COLLECTION ☐ OTHER

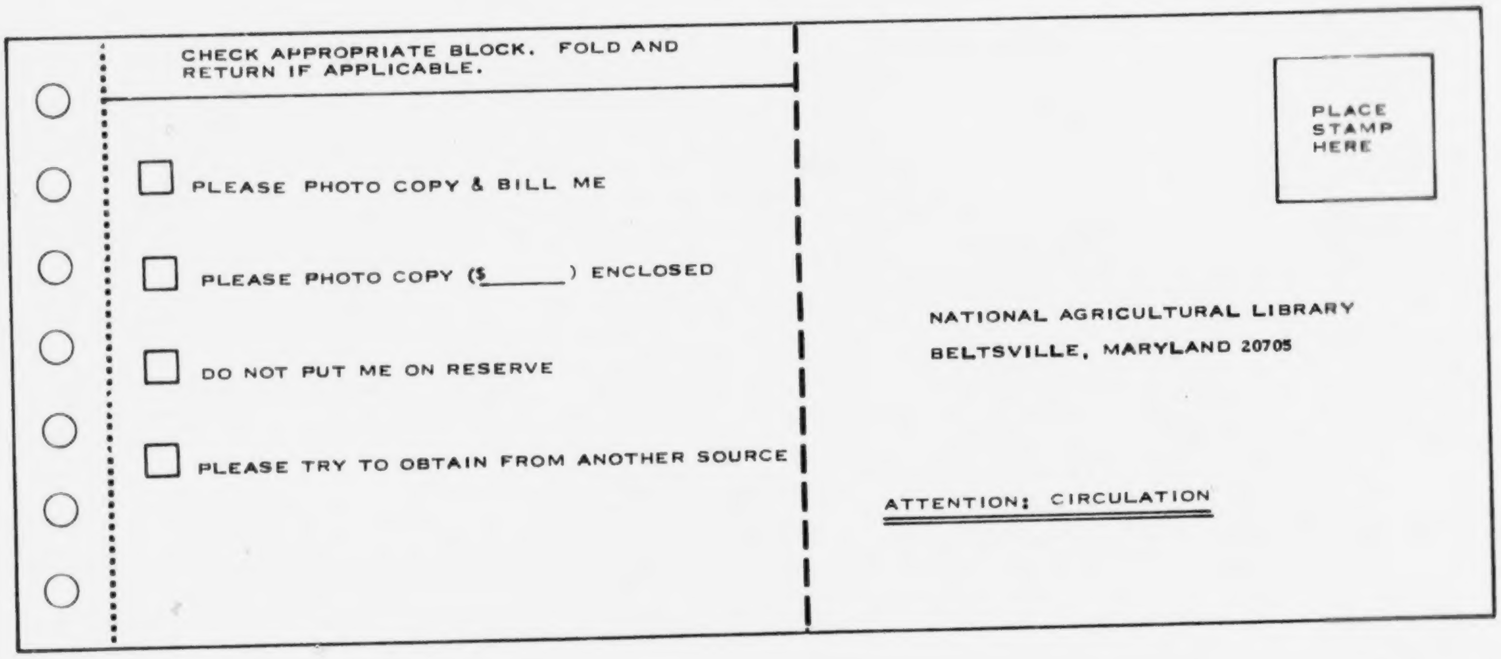
☐ LOST

☐ SEARCHING ☐ PHOTOCOPY CHARGE (RATE–)

☐ CHARGED OUT BUT YOU ARE BEING PUT ON RESERVE

☐ ENCLOSED IS A PHOTOCOPY

FRONT



CHECK APPROPRIATE BLOCK. FOLD AND RETURN IF APPLICABLE.

☐ PLEASE PHOTO COPY & BILL ME

☐ PLEASE PHOTO COPY ($______) ENCLOSED

☐ DO NOT PUT ME ON RESERVE

☐ PLEASE TRY TO OBTAIN FROM ANOTHER SOURCE

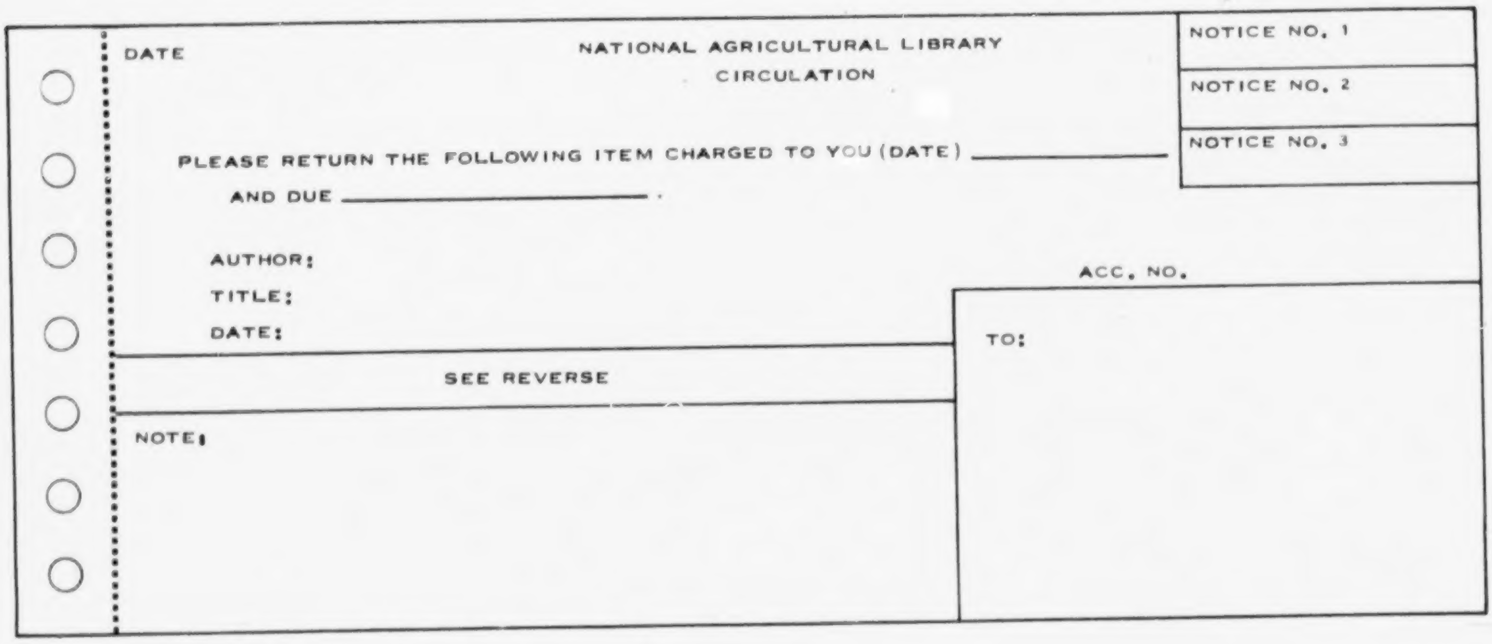
PLACE STAMP HERE

NATIONAL AGRICULTURAL LIBRARY
BELTSVILLE, MARYLAND 20705

ATTENTION: CIRCULATION

BACK

FIGURE 18
Overdue Notice



DATE

NATIONAL AGRICULTURAL LIBRARY
CIRCULATION

NOTICE NO. 1
NOTICE NO. 2
NOTICE NO. 3

PLEASE RETURN THE FOLLOWING ITEM CHARGED TO YOU (DATE) ____________
AND DUE ____________.

AUTHOR:
TITLE:
DATE:

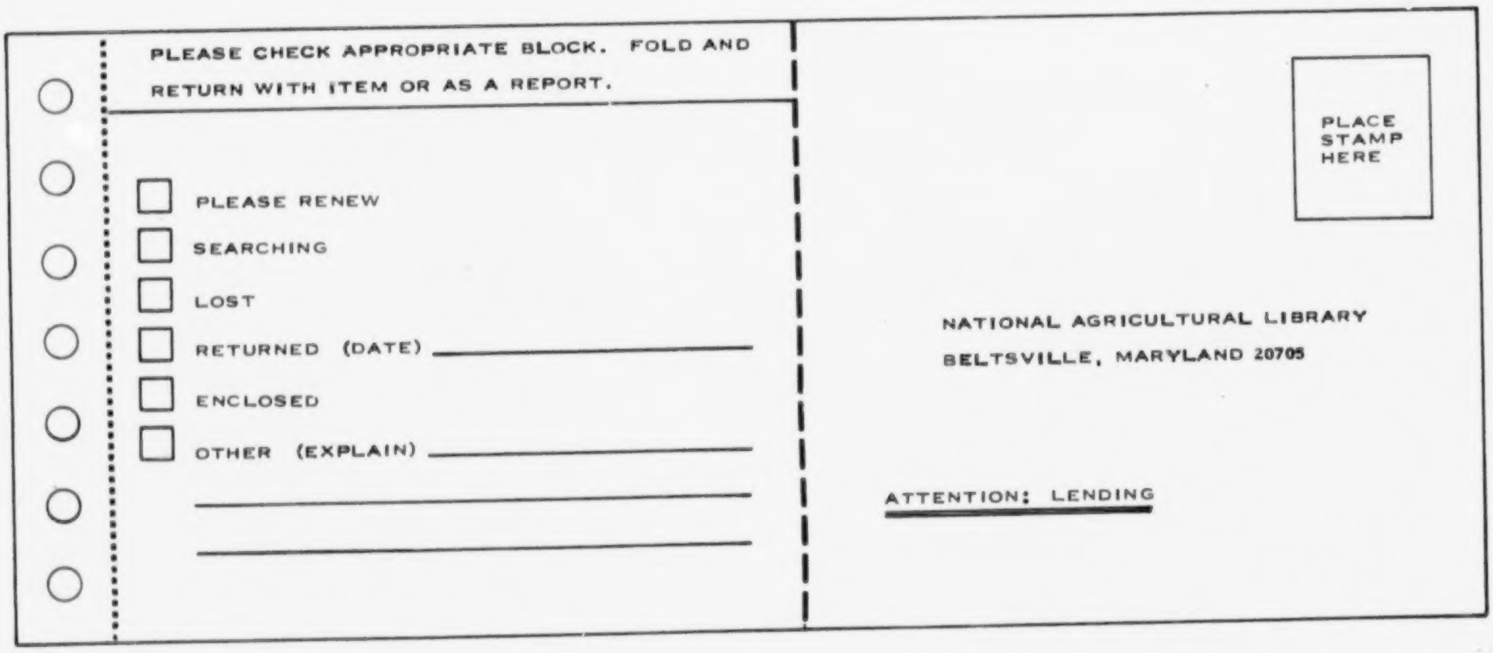
ACC. NO.

TO:

SEE REVERSE

NOTE:

FRONT



PLEASE CHECK APPROPRIATE BLOCK. FOLD AND RETURN WITH ITEM OR AS A REPORT.

- ☐ PLEASE RENEW
- ☐ SEARCHING
- ☐ LOST
- ☐ RETURNED (DATE) ____________
- ☐ ENCLOSED
- ☐ OTHER (EXPLAIN) ____________

____

____

PLACE STAMP HERE

NATIONAL AGRICULTURAL LIBRARY
BELTSVILLE, MARYLAND 20705

ATTENTION: LENDING

BACK

a personal letter advising the borrower of the implications of his actions).

Items returned are checked in by a clerk who inserts the machine-readable card, unique to the item, into a transactor for automatic record updating of both borrower and item status. If the card is missing or mutilated, the clerk manually keys in identification of the item to initiate the process.

A problem affecting many functions of the library, particularly circulation and acquisition, is the completeness of the machine-readable data base. Because of time and budget constraints, there is a tendency to avoid converting the manual file data related to the collection, thus creating a situation where the machine-readable data base relates to only a portion of the library holdings.

An incomplete machine-readable data base also fosters a loss of efficiency in performing acquisition, circulation, and reference functions. This latter problem is created by the necessity to access both the automated and the manual (book catalog) files for document identification and location.

A data conversion plan should be developed and a program approved so that the manual records significant to the operation of NAL are identified and prepared for inclusion in the automated data base.(9, 11)

The staff required to accomplish the circulation function is approximately the same as it is in the current manual system. Some time reductions are achieved in the elimination of card pulling and filing as well as in the automated, routine creation of notices and address labels. The personnel requirements are:

- Professionals. Three professionals supervise and train personnel to work with the automated system.
- Technicians. Six technicians identify and obtain accession numbers of requested items in order to be able to get a location/status report; they also fill secondary supervisory positions.
- Clerks. Six clerks perform duties that include inputting data for loans and user files, mailing out requests, handling the computer-generated claims notices (e.g., mailing), and processing automated check-in of returned items.

All of the previously described terminals (except the label printer) are employed in accomplishing the circulation function. Four CRT/keyboards are used to search for accession numbers and to input and check data added to the files by circulation. Six typewriter terminals are needed to output the location/status reports and to input routine location update data. Two transactors are used to check-in items that include machine cards; otherwise, the check-in is to be accomplished through the typewriter terminals.

(5) Reference

Use of the automated system to fulfill the reference functions will be extensive after a sizable data base has been built. There are, however, no routine tasks to be automated; consequently, there is no specific procedure, no flow diagrams, no special forms for outputs.

The total number of personnel will remain about the same as in the present manual system with the following distribution:

- Professionals (19)
- Technicians (3)
- Clerks (8).

The same staff will be able to handle a larger number and a wider range of requests. The equipment will consist of five CRT/keyboards, each of which will be used in conjunction with a typewriter for hard copy (e.g., bibliographic citations). The special bibliography section will formulate jobs for batch processing and will use the central computing facility directly (with the aid of the programming staff).

In addition, management and administrative data will be provided on a routine batch-processing basis by the reference function. (Appendix B indicates the type of information that can be provided through the system.)

All the formats used for displays and all the data files in the automated system will be available. The exact methods of using these will evolve through experience with this new interface. The use of remote terminals connected to data bases of other collections is anticipated in the future. (See Appendix C.)

2. AUTOMATED FILES

The heart of the NAL automated system is its files of machine-readable data. These files contain the traditional data associated with card catalogs as well as administrative data for circulation and budget control.(12) They are grouped by type and contain extensive cross-references to a consolidated record of all pertinent data on each item in the NAL collection.

(1) Record Structure

Every item in NAL with a distinct title has an accession number (with a dash number for multiple copies). For each accession number there will be a record with all pertinent data associated with that title. The smallest item of data that is recognized by the software is an element. Elements are identified by a three-character numeric tag. All the elements concerning one item in the collection form its record. The tags fall into distinct groups identified by the first digit of the tag:

100	Control Data	500	Subject
200	Entities	600	Serial Data
300	Titles	700	Administrative and Statistical
400	Descriptive	800-900	Unassigned

Within these blocks, the second digit represents a further specificity; e.g., 420 represents language data. The third digit is used to complete the identification tag; e.g., 421 represents the language of the item.

A complete list of these hierarchically-structured tags is given in Appendix D. Within the data elements listed in Appendix D are all the MARC II and Committee On Scientific And Technical Information (COSATI) data elements as well as many others required or useful in the recommended automated system. The fixed format, coded portion of MARC II is included as tag 466 and the legend as tag 741.

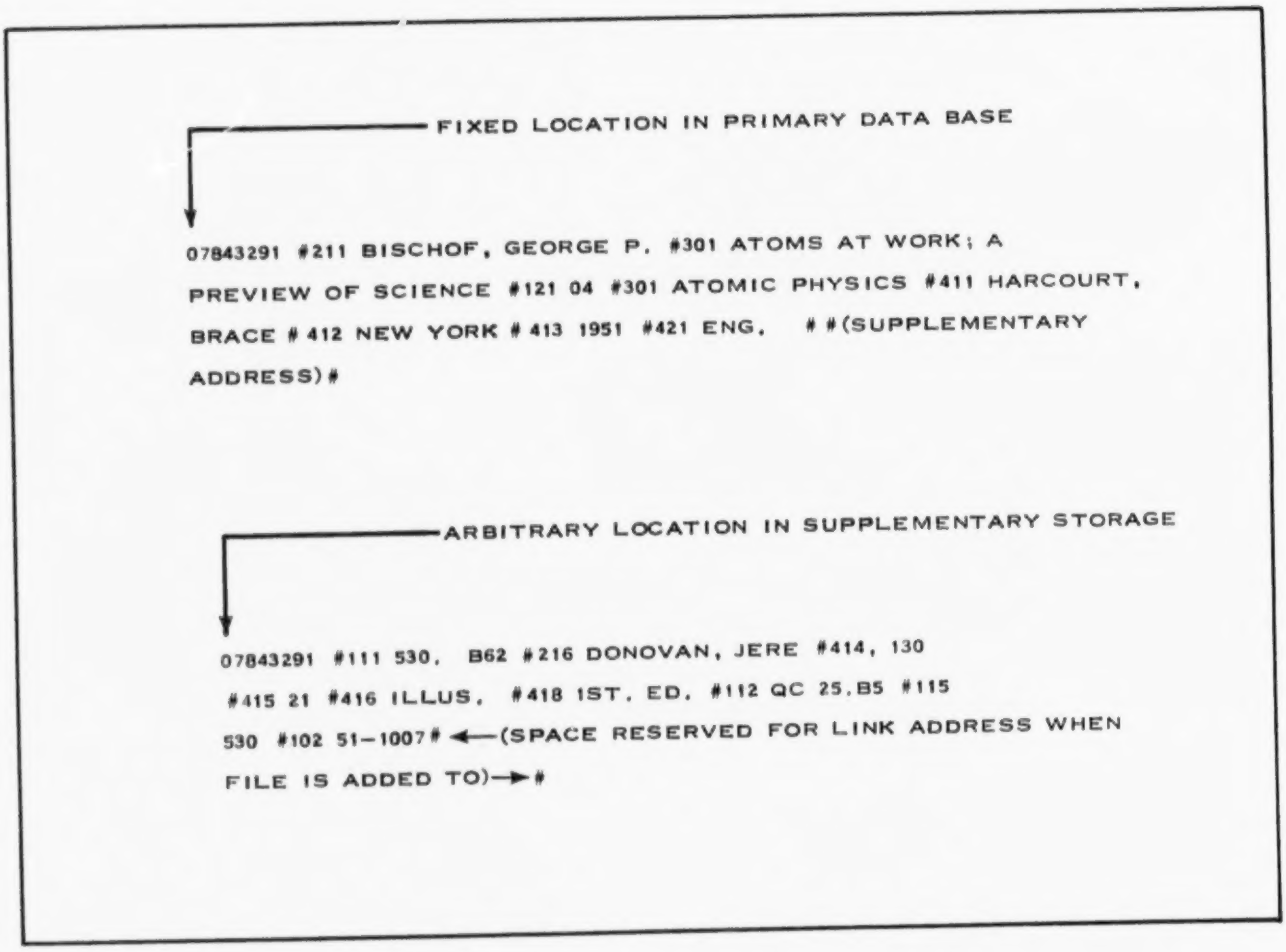
To allow rapid location of the accession number, the length of the data stored following the accession number is fixed at 375 characters, which includes all the primary elements in over 80 percent of the records. A double delimitor near the end of the record signifies that the next group of numerics in the address of a supplementary record contains the remaining data. If an element is added after the final record is filled up, it will be added to the supplementary record. If more than one supplementary record is required, the same type of link is used. Except for repetition of the accession number, no link backward is provided because the items for searching are contained in the indexes and in the primary record. The data elements are all of variable length. A special delimitor is used to locate the tags within a record. This character is recognized in the central processor, can be stored in all memory units, but is ignored by all output devices. A number symbol, #, is used in the examples, but this will not be used in any actual outputs. An example of a typical monographic data record is shown in Figure 19.

For serial titles, additional elements have been added to represent holdings and other data unique to serials. Because no national standard has been set, an all-encompassing but rigidly specified format is suggested to allow translation to a variety of other formats in the future. Specifically, a set of tags for publication pattern subdivision of serial units, holdings, new and old titles, supplements, and indexes have been included in the allowed data elements.

The publication pattern of a serial can be very complex; two types of representation have been included. The simplest is a numeric code (stored in tag 610) for all definable periodicities including the irregular and unknown. If no code seems appropriate, a free-text note is included under tag 614.

A serial is generally subdivided into various units, such as volume, part, and issue; however, the specific relation and exact name of the units take various forms. The same unit

FIGURE 19
Typical Primary and Supplementary
Data for Monograph



```
FIXED LOCATION IN PRIMARY DATA BASE

07843291 #211 BISCHOF, GEORGE P. #301 ATOMS AT WORK; A
PREVIEW OF SCIENCE #121 04 #301 ATOMIC PHYSICS #411 HARCOURT,
BRACE # 412 NEW YORK # 413 1951 #421 ENG.  # #(SUPPLEMENTARY
ADDRESS)#

ARBITRARY LOCATION IN SUPPLEMENTARY STORAGE

07843291 #111 530, B62 #216 DONOVAN, JERE #414, 130
#415 21 #416 ILLUS. #418 1ST. ED. #112 QC 25.B5 #115
530 #102 51-1007# ←(SPACE RESERVED FOR LINK ADDRESS WHEN
FILE IS ADDED TO)→#
```

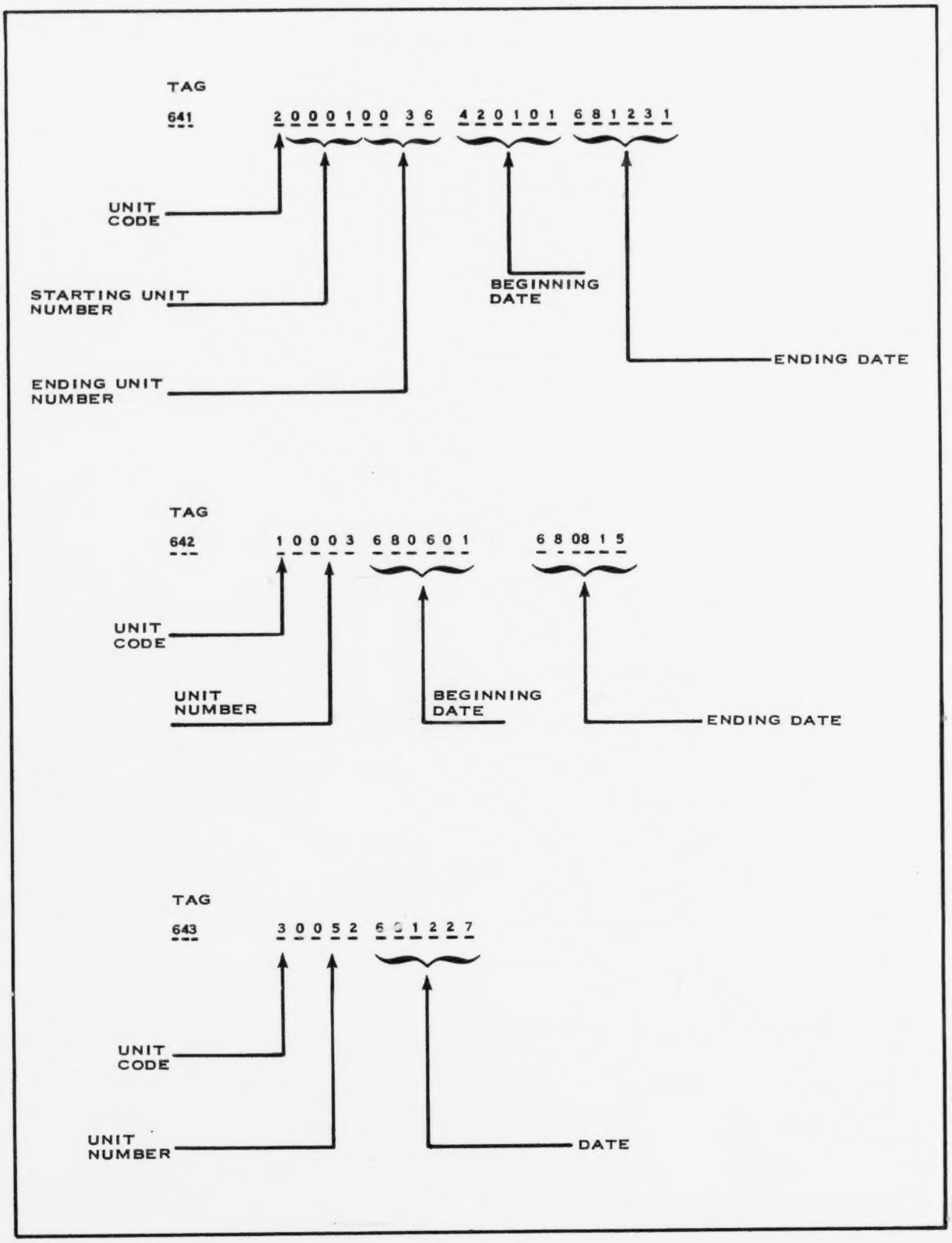
name used by one serial for its lowest subdivision may be used by another for an intermediate of the highest unit. For this reason, three tags are included, 641, 642, and 643, to store the exact names of the units, with 641 containing the highest and 643 containing the lowest. Within the fixed-format holdings data, one-digit codes are used to relate to the specific subdivision unit names.

The fixed-format holdings will be based upon an option to store inclusive data or a complete list of each separable item. Three types of entries are allowed. The first is an inclusive span starting with any of the subdivisions of the serial units and ending with the same unit plus the covered dates. This is used where completeness is to be implied. The second format is for a single higher unit, which may be comprised of several smaller units and which has beginning and ending dates. The third format is for isolated issues or for items that will eventually be carried in the data base as a larger unit (e.g., current issues to be bound when a volume is accumulated).

Holdings data must be in order by ascending date. This fixes the order because data is always a monotonic increasing series (if the order is year, month, day), but unit numbers may not be. If no date is available, holdings are ordered by unit numbers. Any unit can be listed under any appropriate format; the main criteria are whether one or two dates are required and whether one or more pieces are involved. Roman numerals are converted to Arabic. The exact formats are shown in Figure 20.

Normally, there will be one record for each serial title; however, when the description of a serial changes substantially (as established by quality control guidelines), a new accession number will be assigned and a new record created. The most likely cause will be a substantial change in title, but change in any element is also permitted. The first alternative, which can be used for minor changes in the description of a serial, is to simply change the element and add a note with the old information. If the change is insignificant, the record is simply changed; and a printout of the old record is made for the archives. A series of tags (650 series defined in Appendix D) is reserved to allow machine manipulation and retrieval of changed titles. All are fixed format and begin with a six-digit date.

FIGURE 20
Serial Holdings Formats


TAG
641
2 0 0 0 1 0 0 3 6 4 2 0 1 0 1 6 8 1 2 3 1
UNIT CODE
STARTING UNIT NUMBER
ENDING UNIT NUMBER
BEGINNING DATE
ENDING DATE
TAG
642
1 0 0 0 3 6 8 0 6 0 1 6 8 08 1 5
UNIT CODE
UNIT NUMBER
BEGINNING DATE
ENDING DATE
TAG
643
3 0 0 5 2 6 0 1 2 2 7
UNIT CODE
UNIT NUMBER
DATE

The 651 and 652 tags are for straightforward changes. The date is followed by a single accession number to create a link to the old or new holdings data. When several serials merge to form the title of the record under consideration, the 653 tag is used. In this case, the date is followed by as many accession numbers as were involved in the merger.

The 654 tag is used to link a serial that was formed by a split of one title. In this format, the first accession number is the parent serial, and the following accession number(s) represent the other results of the split. The 655 and 656 tags are similar to 653 and 654 but are used to show that the title of the record under consideration merged or split; thus, the 655 and 656 tags create all the needed links in the same fashion as the 653 and 654 tags do.

A distinct record will be kept for each of the multiple copies of a single serial title. The first record will be complete, but the additional records will bear only those elements that are different (e.g., holdings, date received, circulation data, etc.). The automated system will be alerted to the existence of these records by tag 419 (Number of Copies). All records will carry the same accession number, and the first item received will be inputted in the first record and so forth for all other copies. Multiple copies will be identified on the physical item. Circulation control can be maintained by noting the borrower's identification and the particular copy number; thus, the data can be directed to the record of the particular copy.

Two events will trigger, after an appropriate delay, a claim alert for a given serial title. The first is a missing issue that is detected by receiving an issue out-of-sequence. The second is the failure to receive any issue during a fixed period of time after the last issue was received. To handle all possibilities, the system will need four data elements:

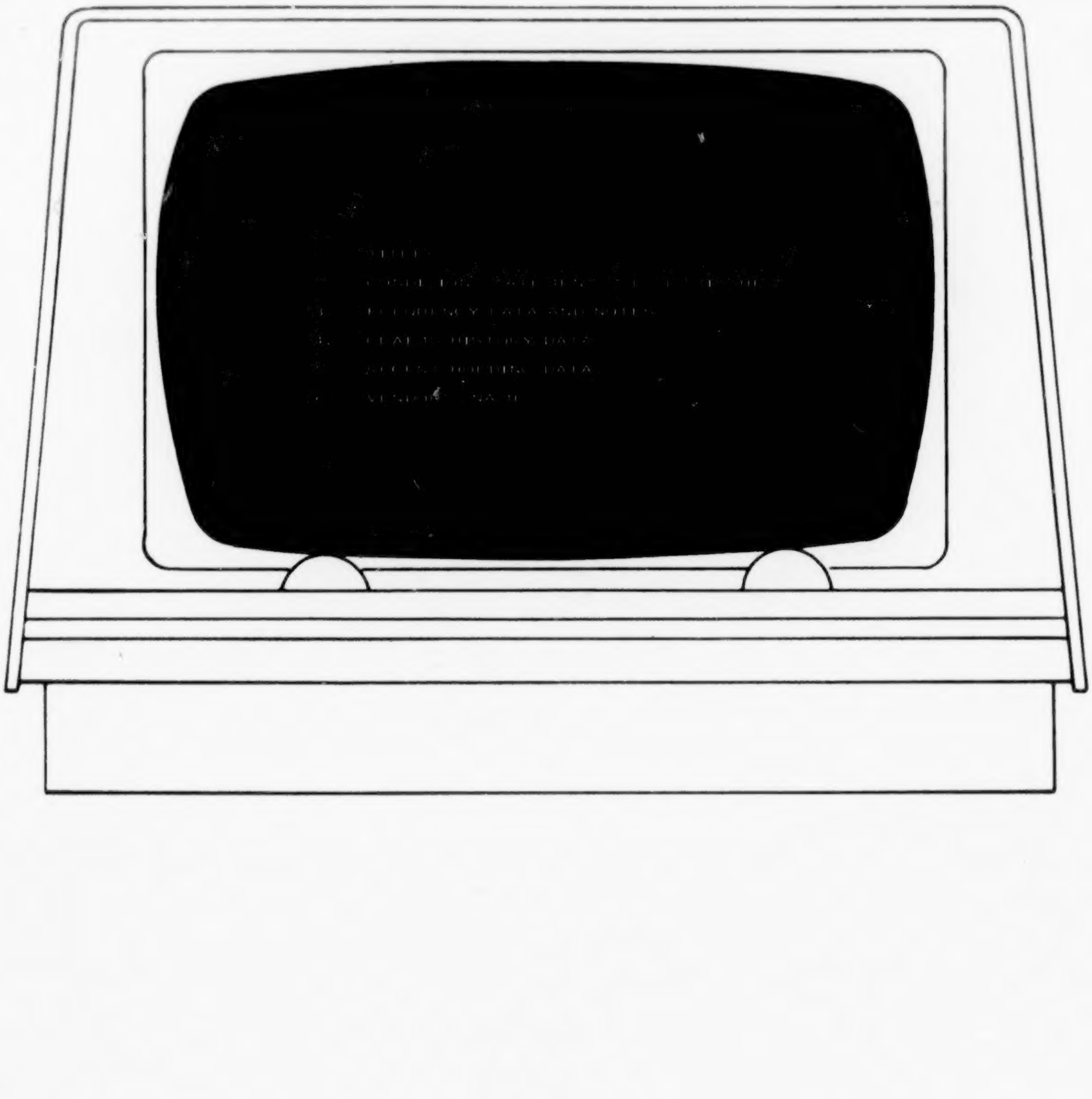
- The date on which the last issue in sequence arrived (Tag 615).
- The date on which an out-of-sequence issue arrived (Tag 616).
- The period in days between sequential issues allowed before a claim alert is created (Tag 614).
- The period in days that is allowed after an out-of-sequence issue is detected before a claim alert is created (Tag 617).

If the two required periods under tags 614 and 617 are not included in the record and if no other data is available for a given serial title, both are assumed by the automated system to be twice the period indicated by tag 610 (frequency code). By using arbitrarily large periods one or both of the events that trigger a claim alert can be suppressed. Thus, if only out-of-sequence issues are to be noted a large number is used for tag 617.

Once each week, on an automatically operated batch program, the entire serial data base will be examined to see if an out-of-sequence has occurred and, if so, how long ago it occurred. If the elapsed time is more than allowed, the pertinent information will be stored in a temporary file. If no out-of-sequence issue has occurred, the date of the last item received is checked to see if the time elapsed has exceeded the allowed amount for sequential issues. If it has, this information is added to the claim alert storage.

At his convenience, a special checker will call up on a CRT the Claim Alert File for review. A typical response is shown in Figure 21. Provision will be made to review only a portion of the list at one time and to return automatically to the proper place in the list at a later time, if necessary. If a claim is to be generated, the system will combine the data

FIGURE 21
Typical Claim Alert Display



from the alert list with the appropriate data from the Renewal and Claim File and will automatically produce a mailable claim notice. If the decision is "no," the alert simply remains in the list and appears in the next review. The Alert File should be completely reviewed once a week; if not, the unreviewed items of the list are printed out for special attention.

Immediately prior to the printing of any claim notice, a last check of the data record will be made automatically to ensure the necessity of the claim. If after a reasonable time no response to a claim notice occurs, the automated system will indicate this fact on a second claim list for the same type of yes/no decision made on the first claim. If the second claim gets no response, the automated system will print out this fact for manual action.

Serial subscription renewal and claim data are maintained in a separate file grouped by renewal months and ordered and identified by accession numbers. Renewal orders are automatically generated unless a stop-order has been previously inputted. For budgetary control, some serials of questionable necessity can be flagged for a composite review to meet a given expenditure constraint. A record is flagged whenever a claim is made against its title. If the claim is not satisfied, the order must be reviewed before an automatic renewal order is issued. The 80-character fixed format of this file is shown in Figure 22.

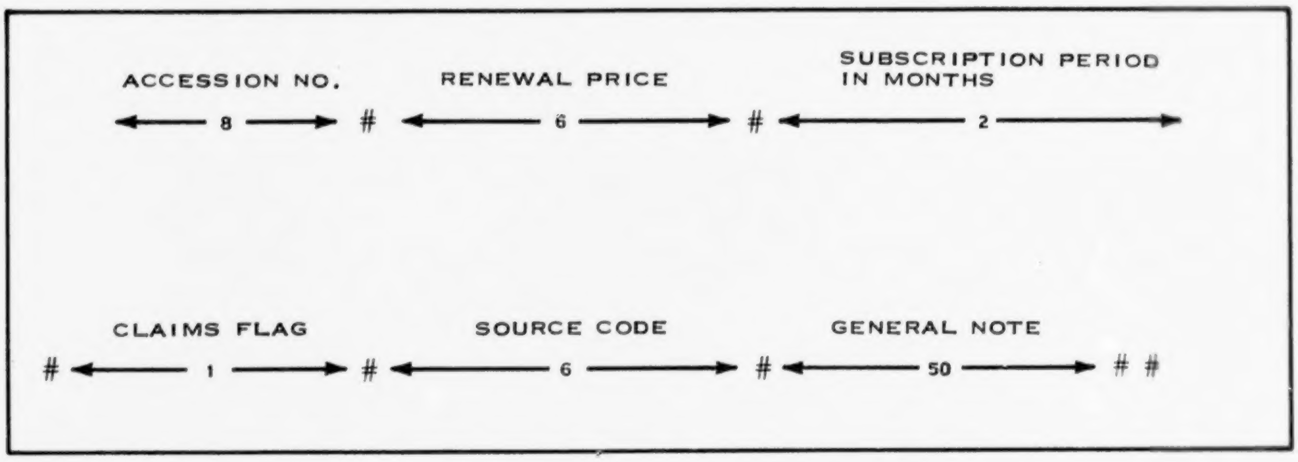

ACCESSION NO.
8
#
RENEWAL PRICE
6
#
SUBSCRIPTION PERIOD IN MONTHS
2
#
CLAIMS FLAG
1
#
SOURCE CODE
6
#
GENERAL NOTE
50
# #

FIGURE 22
Format of Serial Renewal File

(2) Indexes

The four major indexes provide all direct access to the primary data base. Each of these indexes is structured somewhat differently from the others. Because of its length, each has an ancillary table lookup to facilitate a rapid search.

The Author, Title, and Subject Indexes are maintained in alphabetical order. A brute-force search would require far too much time; hence, a form of table lookup is used. Each file is divided into 1,000 roughly equal parts that can be distinguished with four-letter groups. The resulting table is used to find the approximate location of a given entry, and a linear seesaw search continues until either a match of all the letters inputted is made with an index entry or no match can be found.

The format of the Author Index is standard; the surname is first, followed always by a comma and, whenever possible, the full first and middle names. A match consists of an exact comparison between the input and a group of letters in the index of the same length. When this comparison is accomplished for the entire entry, the primary record can be accessed. For example, if one enters the file with only a surname, he would get all entries with that surname. If he adds an initial, he would get not only the ones with that initial but also those with a first or middle name that would have that initial.

To facilitate rapid searching, the length of each author entry is limited to a fixed length of characters for the author and the numbers of characters required for a link address. This link accesses the remaining characters in the author's name and lists in a variable-length format all accession numbers associated with that author (either as main entry, subject, etc.). Only rarely will this supplementary data need to be accessed. The Author Index format is shown in Figure 23.

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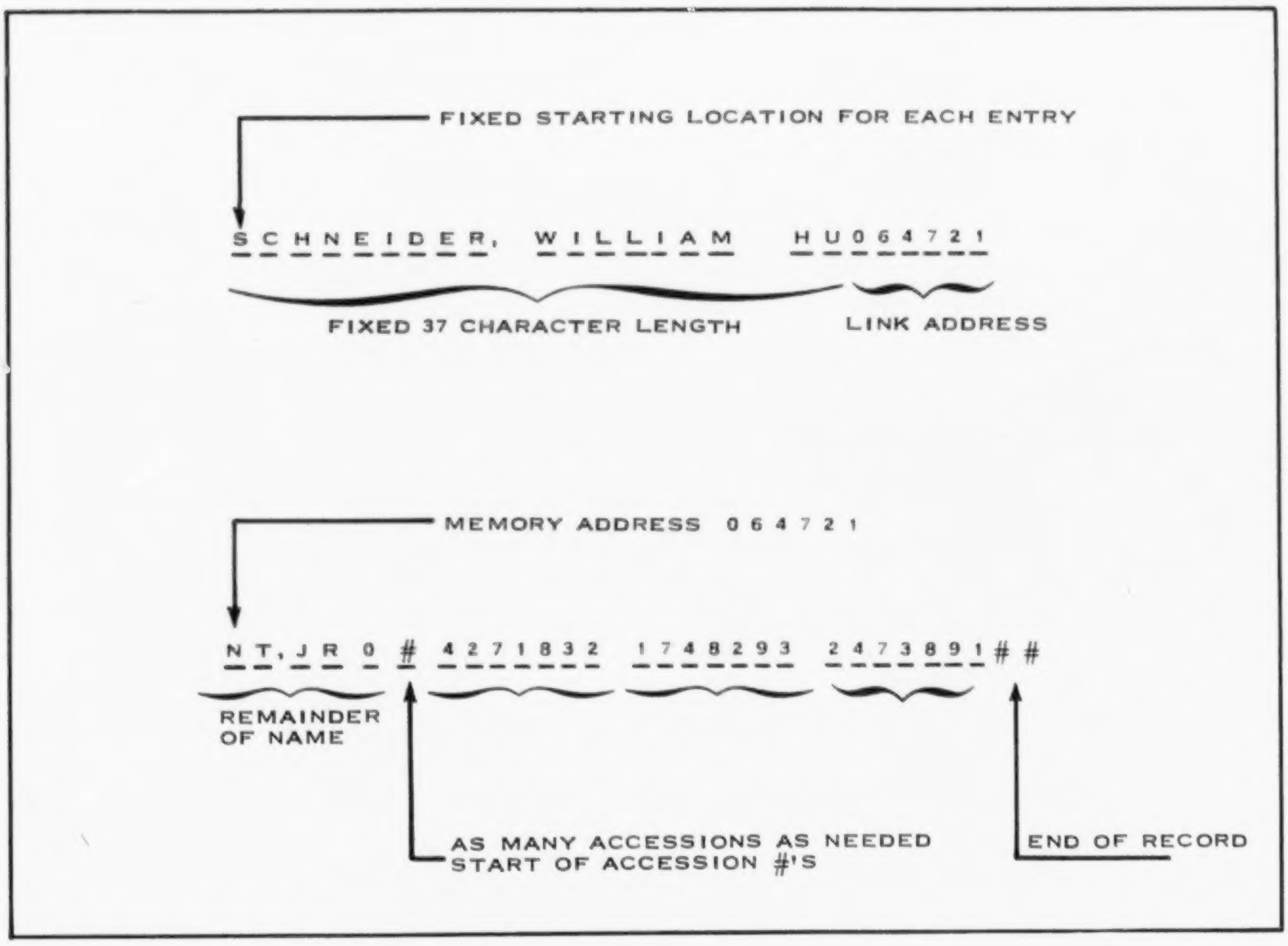
FIGURE 23
Format of Author Index


FIXED STARTING LOCATION FOR EACH ENTRY
SCHNEIDER, WILLIAM HU064721
FIXED 37 CHARACTER LENGTH
LINK ADDRESS
MEMORY ADDRESS 064721
NT,JR 0 # 4271832 1748293 2473891##
REMAINDER OF NAME
AS MANY ACCESSIONS AS NEEDED
START OF ACCESSION #'S
END OF RECORD

Variations in spelling, form, and pseudonyms are allowed in the Author Index. The forms listed in a primary record are used to create an authority. This is handled automatically by inputting, in full, a form of the name that is available and a request for an authorized form. The system responds with one or more names, and, if the user needs further identification, the primary records and even the supplementary will be displayed on command.

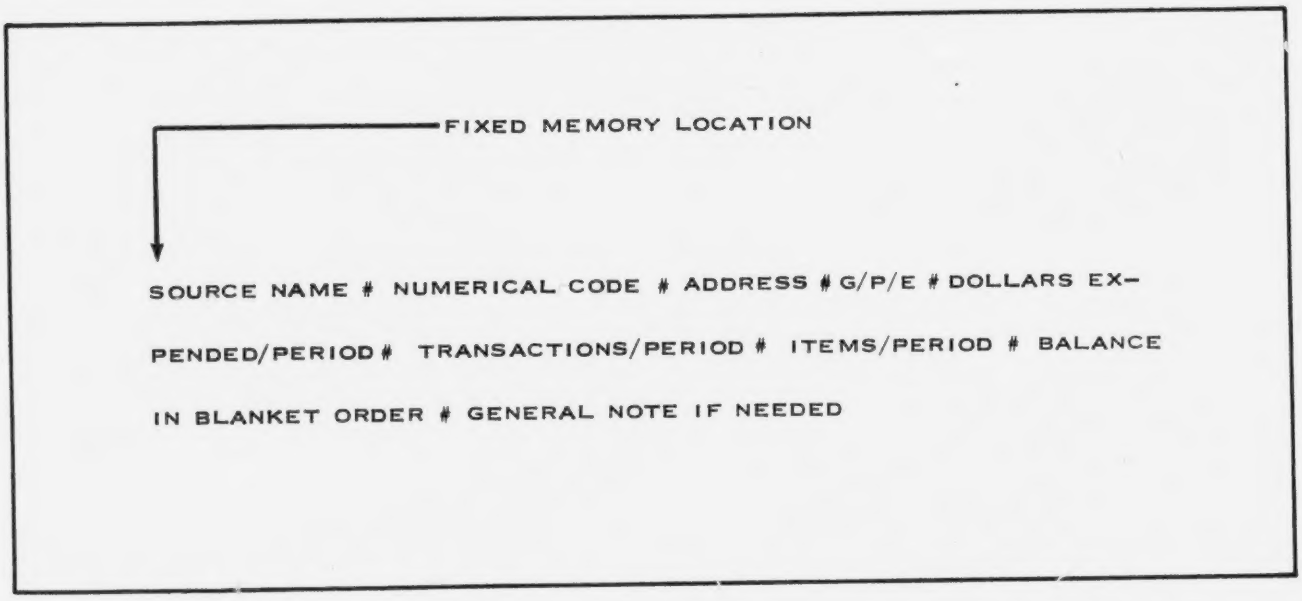
The Title Index will be handled in the same way as the Author Index except that there will seldom be more than one accession entry under a title. Current uniform title practices of NAL will be used, but variations in form will be allowed as much as possible. If the correct form of a title is required, the same procedure is used as with the author authority.

Although there is no specific requirement for subject searches, a file containing the NAL Agricultural/Biological Terms is included in the design. The structure will be the same as that for the Author Index. When a subject term is added (by cataloging) as an entry in the item record, the accession number is automatically added to the Subject Index.

(3) Auxiliary Files

An up-to-date list of sources of new material for the collection must be maintained in machine-readable form to provide these data to a variety of users simultaneously and to allow machine generation of orders on request. This list includes in alphabetical order U.S. and foreign vendors and exchange and gift sources. In addition, it should include a numerical source code, the type of source, current address, dollar volume over some specified period, number of transactions and items involved in this period, remaining balance in blanket orders, and any other data pertinent to a particular source, such as performance. In addition, a file of source codes with the machine location of the total record of each source should also be provided to allow rapid retrieval of the data. With the exception of the cost data, similar data should be included for gift or exchange sources, if they are permanent.

To expedite searching, the order of the elements is fixed, although the length of the individual elements is variable. The elements are separated by the standard delimitor character, and elements not present initially are reserved for a proportionate part of the available length of 350 characters. This format is shown in Figure 24.



SOURCE NAME # NUMERICAL CODE # ADDRESS # G/P/E # DOLLARS EXPENDED/PERIOD # TRANSACTIONS/PERIOD # ITEMS/PERIOD # BALANCE IN BLANKET ORDER # GENERAL NOTE IF NEEDED

FIGURE 24
Format of Source File

An up-to-date Borrower File will be kept for circulation control purposes; i. e., location, recall, and overdues. This file will include the borrower's complete name and address/ location, the accession number of charged items, and overdue notices sent. This file will also be used for automatic generation of a mailing label. A fixed order but variable element-length format is used with an overall length fixed at 150 characters. The format is shown in Figure 25.

```
BORROWER'S NAME $ ADDRESS $ ACCESSION NUMBERS AND
DATES OF ITEMS CHARGED $ OVERDUE NOTICE SENT ON (DATE) $$
```

FIGURE 25
Format of Borrower File

To allow swift entry into the system when only an order number is known, a file of outstanding orders will be maintained by purchase order number with the corresponding source code. This is a fixed format of 10 characters for order number, 6 characters for source code, and 40 characters for five purchase order numbers. If the order is for more than five items, the order number will be repeated as a new record in this file.

(4) File Updating

Individual records are created over a period of time by various additions, deletions, and reviews. Because of this, two levels of storage are proposed. Both are permanent in that they are held in nonvolatile disk or bulk storage. The ability to make changes in the permanent data, however, is limited to selected terminals and personnel, and such changes are subject to a more elaborate review procedure. The temporary records will be in essentially the same storage media but will be less protected from change. In general, a record will remain temporary as long as any processing is still being done. The last step before an item is sent to the shelf is a quick review of the data stored. A file (author, title, or primary data base) has records in various states of finality; however, this does not preclude a complete response of the automated system because it can assemble a record or search a file that is in any multiplicity of storage locations.

3. HARDWARE PERFORMANCE DESCRIPTION

A variety of hardware configurations could accomplish the system requirements, and each configuration would dictate different details of software design; therefore, the system has been specified by its performance. To the extent practicable, this system description will be on a function by function basis at the highest level consistent with adequate detail. In this way, the widest competition among suppliers will be ensured, and unique equipment or proprietary techniques available from a single source will not be required.

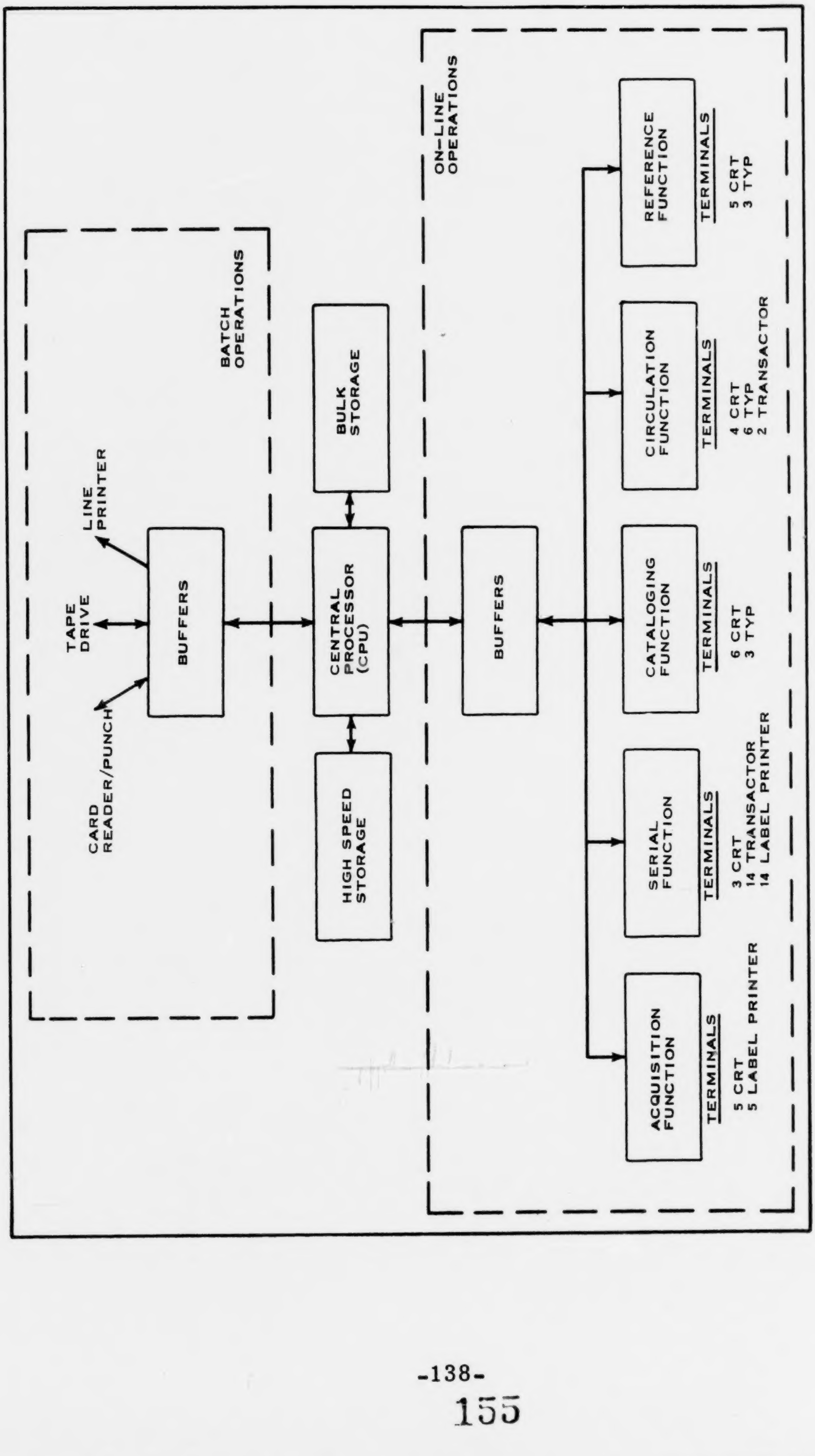
A typical hardware configuration that provides all the functional operations outlined in this report is shown in Figure 26. The details of the particular interface are not critical provided that there is appreciable room for expansion in the number of input/output channels. The satellite computer may or may not be required in the bulk storage transfer channel if operational logic is provided either in the main storage unit or in the existing input/output channels of the central processing unit (CPU). It does not matter how the functional tasks to be accomplished are distributed in the system; the total complexity will be essentially the same and will be reflected in total cost.

(1) Central Computing System

The computer main frame, its input/output channels, buffers, core storage, and local peripherals constitute the central computing system. The system must have the following capabilities:

- To provide control of and communications with a minimum of 40 real-time input/output channels for remote display and data input

FIGURE 25
System Hardware Configuration


BATCH OPERATIONS
CARD READER/PUNCH
TAPE DRIVE
LINE PRINTER
BUFFERS
HIGH SPEED STORAGE
CENTRAL PROCESSOR (CPU)
BULK STORAGE
BUFFERS
ON-LINE OPERATIONS
ACQUISITION FUNCTION
TERMINALS
5 CRT
5 LABEL PRINTER
SERIAL FUNCTION
TERMINALS
3 CRT
14 TRANSACTOR
14 LABEL PRINTER
CATALOGING FUNCTION
TERMINALS
6 CRT
3 TYP
CIRCULATION FUNCTION
TERMINALS
4 CRT
6 TYP
2 TRANSACTOR
REFERENCE FUNCTION
TERMINALS
5 CRT
3 TYP

- To provide adequate, rapid core storage for the executive program and for subroutines required to operate the system and to provide such storage for the data being manipulated

- To satisfy an average throughput time for typical transactions of 2 minutes, for a typical mix of approximately 8,000 transactions per day, randomly distributed over the 40 channels

- To accept and produce 9-channel magnetic tape in the American Standard Code for Information Interchange (ASCII) format

- To read and punch standard 80-column Holerith cards

- To provide formatted line-printer outputs of the required character set at high speed on various special forms.

Specifically, such characteristics as word length, command execution rate, command structure, number of index registers, and size of the core storage should not be in an equipment specification issued for bids. This permits the manufacturers to make trade-offs among the specific capabilities of the CPU, the input/output structure, and the bulk memory.

(2) Bulk Storage

Two types of bulk storage are required: a moderately fast unit for storage of indexes and program routines and a larger, slower unit with very low cost per bit stored. The only candidate for the first category is a disk unit having the following characteristics:

- Stores 50 to 100 million characters.
- Transfers data at a rate of about 100,000 characters per second.
- Is randomly addressable, at least to the level of an index entry of 30 to 50 characters.

The primary consideration of the slower bulk storage is to provide a massive storage at a reasonable cost; however, the following features are also required:

- Initial capacity of 400 million characters with modular expandability at the same or lower cost per character.
- Capability of being randomly addressed to a level as small as a primary record or at least to two or three such records.
- Average access time (including latency and transfer) to a series of independently addressed records consistent with the overall system response time of 2 minutes.

(3) Remote Terminals

A minimum number of different terminal types are specified for this system to allow simplified maintenance and lower initial cost. The four required types are a CRT/keyboard, a typewriter, a transactor, and a character printer.

The most important component of the system is a visual display built around a CRT and a keyboard that must have these characteristics:

- Can display at least 10 and preferably 20 lines of 30 characters each
- Is easily legible at a distance of 3 to 4 feet under normal illumination of a modern office
- Provides a keyboard with all requisite characters as well as a small number of function keys
- Provides self-contained buffering, formatting, and editing features.

In addition, it is highly desirable that the full character set used internally in the Document Location and Control System (DLCS) be displayed. Only if appreciable cost penalties are incurred should a smaller set be used. In any case, upper- and lower-case alphabetic characters must be displayed.

A typewriter output is used to provide short hard copies in the required character set. The unit must provide an output rate of at least five to ten characters per second. If it is used in conjunction with a CRT terminal, it should share the same buffering and control logic. The typewriter is not intended for producing extensive listings; these will be done on a batch basis by using the line printer associated with the central computing system.

The typewriter keyboard must have 26 Roman lower-case letters, 26 Roman upper-case letters (via shift key), 10 Arabic numerals, and 26 symbols. These symbols should include those of the NAL standard character set (shown in Table 7) whenever common to the MARC II character set used by the Library of Congress. Four keys will be nonspacing to provide 8 over-the-letter diacritical marks.

A device designed primarily for input is needed for serial check-in. This device, called a transactor, can also be used in several other areas. It has the following characteristics:

- Ability to read the first 8 to 20 characters of a single, manually inserted, punched card
- Numeric input keyboard plus 5 to 10 function keys
- Five to 10 fixed output messages in the form of lighted panels
- No elaborate self-contained control circuits or buffering.

Table 7
NAL Standard Symbols

Breve	‿
Quotation	"
Left Bracket	[
Right Bracket	]
And	&
Apostrophe	'
Left Parenthesis	(
Right Parenthesis	)
Underline	___
Hyphen	-
Tilde	~
Cedilla	¸
Diaeresis	..
Circumflex	^
Asterisk	*
Dollar	$
Grave Accent	\
Acute Accent	/
Question Mark	?
Virgule	/
Semicolon	;
Period	.
Colon	:
Comma	,
Ligature	⁀

Such a device can also be used in circulation for checking items in and out. The transactor may not be available off the shelf in a form that exactly conforms to the requirements, but an existing unit can be modified, or existing components can be combined. In some applications, it will be used in conjunction with a numeric keyboard with a few function keys.

A simple, single-character alphanumeric strip printer is also needed for making accession number labels. The device can be slow, one or two characters per second, but it must be able to handle self-adhering material. This device need only buffer one accession number at a time and requires no special control features.

4. SOFTWARE DESCRIPTION

The software package required to operate a system of this complexity must be organized into many smaller portions so that a large number of programmers will be able to write it simultaneously. Some portions of the software may already be available for particular equipment; however, it is impossible for any general-purpose software furnished with the equipment to accomplish more than a small portion of the needed tasks.

Four types of programs will be required. An Executive Routine will form the master control of the system and will keep track of multiple jobs, input/output latency periods, and general system operations. Input/Output Routines written as freestanding subroutines will be used to fetch data in storage, to format data, and to create outputs at real-time displays or on the peripherals of the central computing system. Service Routines will be NAL-task-oriented and will make use of the various input/output programs. File update and demand batch processing form the fourth group; this will be referred to as Background Programs.

(1) Executive Routine

The Executive Routine forms the primary control of the system by allocating core memory, recognizing interrupts, determining the order of execution, storing the status and data of interrupted programs, and monitoring time sequence and duration of all events. In addition to its basic structure, it is made up of the following major subroutines:

1. Real-Time Interrupt - recognizes input queries and identifies the source to the Executive Routine.
   - Input - coded real-time interrupts
   - Output - identification and timing data.

2. Program Swapping - takes program currently being processed and stores the contents of registers, intermediate answers, and the data being acted upon in disk storage. Program Swapping also reverses this process by restoring partially completed routines.

   - Input - called program
   - Output - status contents of preempted program and location where stored.

3. Program Switch - determines when a service routine will be held up while awaiting data. Switches to interrupt while awaiting immediate service, or, if there are no real-time requests, switches to background batch programs. Program Switch also assigns a number to each query or service requested.

   - Input - time monitor
   - Output - identification of next program to be serviced and query number.

4. Service Sequence - determines what service routine(s) are needed for a given query, formulates appropriate breakpoints, and structures initial input conditions to begin first service routine.

   - Input - output of real-time interrupt routine
   - Output - list of subroutines and initializing values.

(2) Input/Output Routines

Each of these routines acts independently, and several may be used to accomplish a single query.

1. Query Fetch - takes data from a remote terminal and transfers it to core storage in a specified format. Query Fetch also satisfies any unique action required by the terminal (e.g., start-stop commands).

   - Input - terminal to be serviced

   - Output - identified and formatted query or inputted data.

2. Bulk Memory Fetch - checks requester identification if the request is for limited data, and sets up a transfer of a block of data from bulk storage to core storage or, in some cases, to high-speed disk.

   - Input - start address and length or start/stop address

   - Output - new location of data.

3. Bulk Memory Store for Permanent Data Base - checks source authority, restores data in original location after change, or determines location for new data by keeping track of available space. This subroutine also enforces format and length requirements of files and adds chain link when needed.

   - Input - current location of data and former location in bulk memory if data have changed

   - Output - none for primary data base; update data for indexes.

4. File Update Input to Intermediate Data Base - identifies source and confirms authorization; structures record in storage format, adding necessary tags; restructures changed portions if record already exists; and ensures compliance with storage format requirements. This subroutine transfers file update input to proper file of intermediate data.

- Input - data from terminal

- Output - properly formatted data for data base.

5. General Bibliographic Format - takes data in a record and translates tags to create a general reference format; identifies nonobvious items in English words; creates notes about data contained but not displayed.

   - Input - data record

   - Output - formatted and identified data for display.

6. Index Transfer - locates where input is in index by using directory to index and then starts transfer of data around approximate location.

   - Input - author, title, accession, or subject.

   - Output - selected data from index.

7. Special Output Formats - Several routines for formatting and identifying data are needed for real-time and batch.

8. Oversize Retrieval - provides notice to user of large retrieval for a search query, and asks for instructions for outputting.

   - Input - (first) search routine overflow, (second) display instructions.

   - Output - number of retrieval operations, including index outputs, authority statements, orders, serial claims notices, order claims notices, renewal orders, descriptive cataloging, short bibliographic lists, document location and status reports, overdue notices, binding notices, and MARC II, COSATI, and error message formats.

9. Display Paging Routine - recognizes characteristics of terminal being served; provides forward/backward movement for several queries simultaneously through data already formatted.
    - Input - type of terminal query number, location of data
    - Output - next location to be transferred.
10. Accession Label - controls remote generation of accession label.
    - Input - accession number and terminal addressed
    - Output - accession number.
11. Serial Holdings Data - fetches and translates coded serial holdings data, and formats them for display.
    - Input - accession number
    - Output - formatted serial holdings.

(3) Service Routines

These routines are task oriented and relate to each specific work function aided by the NAL automated system. Each routine sets up a sequence of other, more specific, subroutines and links outputs and inputs of each.

1. Selection Citation - accepts data on item selected; checks data base for existing items.

- Input - author or title, or both
- Output - no records found.

2. Order Generator - (i.e., purchase, gift, or exchange) - accepts initial descriptive-cataloging data, number of copies desired, source to be used, assigned order number, price; creates order in storage.
   - Input - selection citation, source selected, number of copies, and other elements (i.e., price, edition, etc.)
   - Output - formatted order for later batch printout.

3. Acquisitions Check-in - accepts data from prepunched card received with ordered item; displays all pertinent stored data and accepts corrections and additions; assigns accession number; and initiates label generation. (The same procedure is performed for exchange and gift requests.)
   - Input - order number
   - Output - accession label. (Same routine for exchange and gift requests.)

4. Unordered Acquisition - combines appropriate portions of selection citation and acquisitions check-in program for gifts that are selected for addition to the collection.
   - Input - descriptive cataloging
   - Output - accession label.

5. Serial Check-in Sequence - identifies and fetches serial record needed; requests check-in data item by item; verifies data for reasonableness; updates serial holdings data; and initiates accession-number label printout.

- Input - accession number, serial issue identification

- Output - verification to checker, file update, and label.

6. Circulation Control - accepts data from card with each item and uses information to update location and status.

   - Input - accession number, location, and status

   - Output - file update of status.

7. Author Search - accepts partial or complete name and attempts match against author file; has provisions for truncation or initial.

   - Input - author

   - Output - matching or near-matching names and corresponding numbers.

8. Title Search - accpets title and looks for exact match; if match is not found, attempts several alternative orders and truncated forms.

   - Input - title

   - Output - matching or near-matching title(s) and corresponding accession number.

9. Subject Search - accepts exact form of subject term and lists accessions under that subject.

   - Input - subject term

   - Output - accession numbers of items with that subject term.

10. Accession Search - takes accession number(s) from input query or output of another routine and lists title and author of each for lists or for a complete record of selected titles.

    - Input - accession number (s)

    - Output - bibliographic citation.

11. Document Location Report - uses title, author or accession number to retrieve complete status information.

    - Input - title, author, or accession number

    - Output - title, author, and detailed status (location, date due, borrower, etc.)

12. Author Authority - Combines author search with retrieval of elements from appropriate records to provide a dialogue for establishing author identity; provides authorized form of name.

    - Input - author's name

    - Output - authorized version of name.

13. Source Search - searches source file by name or vendor code and translates data for output format.

    - Input - source name or code

    - Output - complete formatted source data.

14. Tag Retrieval - fetches from a single record element(s) identified on input by tag number; identifies on output by element name unless the data is self-explanatory.

    - Input - accession number plus string of tags.

    - Output - formatted and identified retrieval of selected elements.

15. Error Routines - examines in-service problems or input/output routines and offers canned suggestions to source when appropriate.

    - Input - error detection in system
    - Output - error correction statements.

(4) Background Programs

A variety of background programs for batch processing will be needed by the NAL automated system; these are described in this section.

1. Index File Update - takes an accumulated group of new or changed entries for one of the ordered files and rearranges the file to include the new or changed entries.

    - Input - new or changed pieces of information.
    - Output - correct and updated index files.

2. General Listing Program - lists elements of records selected on a logical basis, such as titles in a certain subject, books by a corporate author, etc.

3. Order Generator - converts stored order requests into printed outputs on special form.

    - Input - order requests
    - Output - orders ready to review for mailing.

4. Serial Claim Alert - searches serial data base for serials with items overdue, provides list with title, date last issue received, stored alert time, and brief claims history.

   - Input - serial data base

   - Output - serial claim alert list.

5. Serial Claim Notice - combines serial claim alert with renewal data to create and format a serial claim.

   - Input - selected items from serial alert list

   - Output - serial claims on special form ready for mailing.

6. Order Claim Alert - searches order file to find whether expected receipt date is exceeded by some fixed amount. Formats data from item record and vendor source file for list.

   - Input - order file

   - Output - overdue orders list.

7. Order Claim Notice - selects and formats data from alert list to create claim notice.

   - Input - selected items from order alert list

   - Output - printed claim for review.

8. Statistical Tabulation - searches files and computes required statistics or locates existing running tabulations; formats data for output.

   - Input - items to be reviewed and selected parts of data base

   - Output - format reports of required statistics.

9. Bindary Notice - searches serial data base for items ready to be bound (e. g., fixed number of issues received per title, etc.); formats binding instructions.

   - Input - serial data base

   - Output - binding notices on special form.

10. MARC II Input - searches data base to see if author or title is contained in existing data base for items in subject area. If not, prepares listing of selected records for review by acquisition.

    - Input - MARC II tape

    - Output - list of non-NAL items in field of interest.

11. MARC II Conversion - converts MARC II record to NAL format and transfers it to data base.

    - Input - MARC II - identification numbers

    - Output - records in NAL format.

12. MARC II Output - translates NAL format into MARC II format and writes record on tape.

    - Input - accession number(s)

    - Output - MARC II tape.

13. Payment Authorization - notes each fulfilled order and accumulates, by vendor, a weekly list for payment authorization.

    - Input - purchased item checked-in by acquisition

    - Output - list by vendor of fulfilled orders with cost.

CHAPTER V

IMPLEMENTATION

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IMPLEMENTATION

The design and operating characteristics of an automated document control system have been discussed in the earlier chapters of this report; it is now appropriate to address the methods and timing for implementing the system. The essential components of implementation will be:

- Determine appropriate priorities and a schedule that will meet the dual criteria of the urgency of the need and the availability of funds.
- Contract for the necessary hardware/software package and data conversion.
- Ensure that adequate numbers of technically competent personnel are available to implement and to operate the system.
- Provide adequate training of personnel who will maintain, operate, and/or use the system.

The structure of the implementation plan and the accompanying schedule are predicated upon the assumption that NAL will implement the system as rapidly as practical.

It is estimated that, through a combination of in-house and contracted efforts, an efficient implementation may be brought about over a 33-month period. This schedule may be shortened or lengthened to some extent to conform with the availability of funding or of critical personnel, but significant deviations will reduce program effectiveness.

1. IMPLEMENTATION PRIORITIES AND RECOMMENDED SCHEDULE

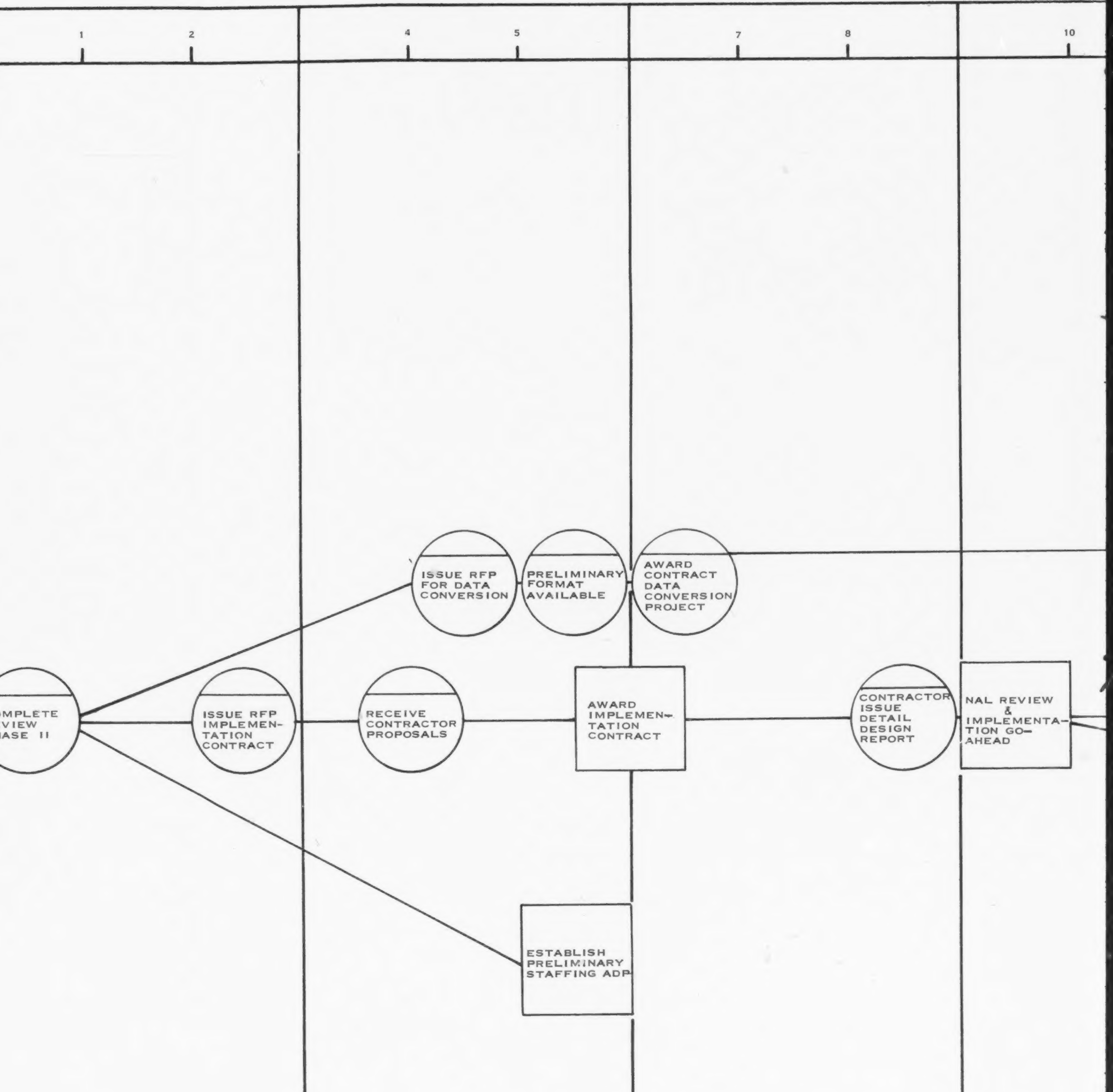
It is neither practical nor desirable to attempt to implement the entire, automated, document-control system at one time. It is more appropriate to build and to integrate into the current operations a series of discrete functional capabilities. In this way, an orderly, concurrent development of hardware, software, data base, procedures, and competent personnel may be achieved. The schedule for development and implementation of the various system capabilities is based upon the following:

- Operational benefits
- Estimates of the time and cost involved in its implementation
- Interdependencies between functions.

Implementation of the proposed system design is predicated upon the use of additional resources—both in-house and contracted—to bring the new system capabilities up to operational status on a function-by-function basis. As this is accomplished, the current manual methods can be phased out; the personnel involved can be assigned to other tasks. The period during which such parallel operations are required will vary, depending upon the particular subsystem capability being implemented. The minimum period will apply to such operations as purchasing, in which a full conversion could be effected in about three months; at the other extreme, general catalog searches will take an indefinite period, depending upon the choice of methods of converting the pre-1966 catalog.

All functions except those of serial record and control will continue with some form of manual operations after the initiation of machine-assisted operations. These manual operations will involve the use of those catalog records prior to 1 January 1966. It is assummed that all functioning areas will require an NAL-printed catalog to centralize the information needed per function.

The recommended plan and schedule for implementation presented in Figure 27 has been designed to accommodate parallel manual operations and contractor-assisted systems development. The use of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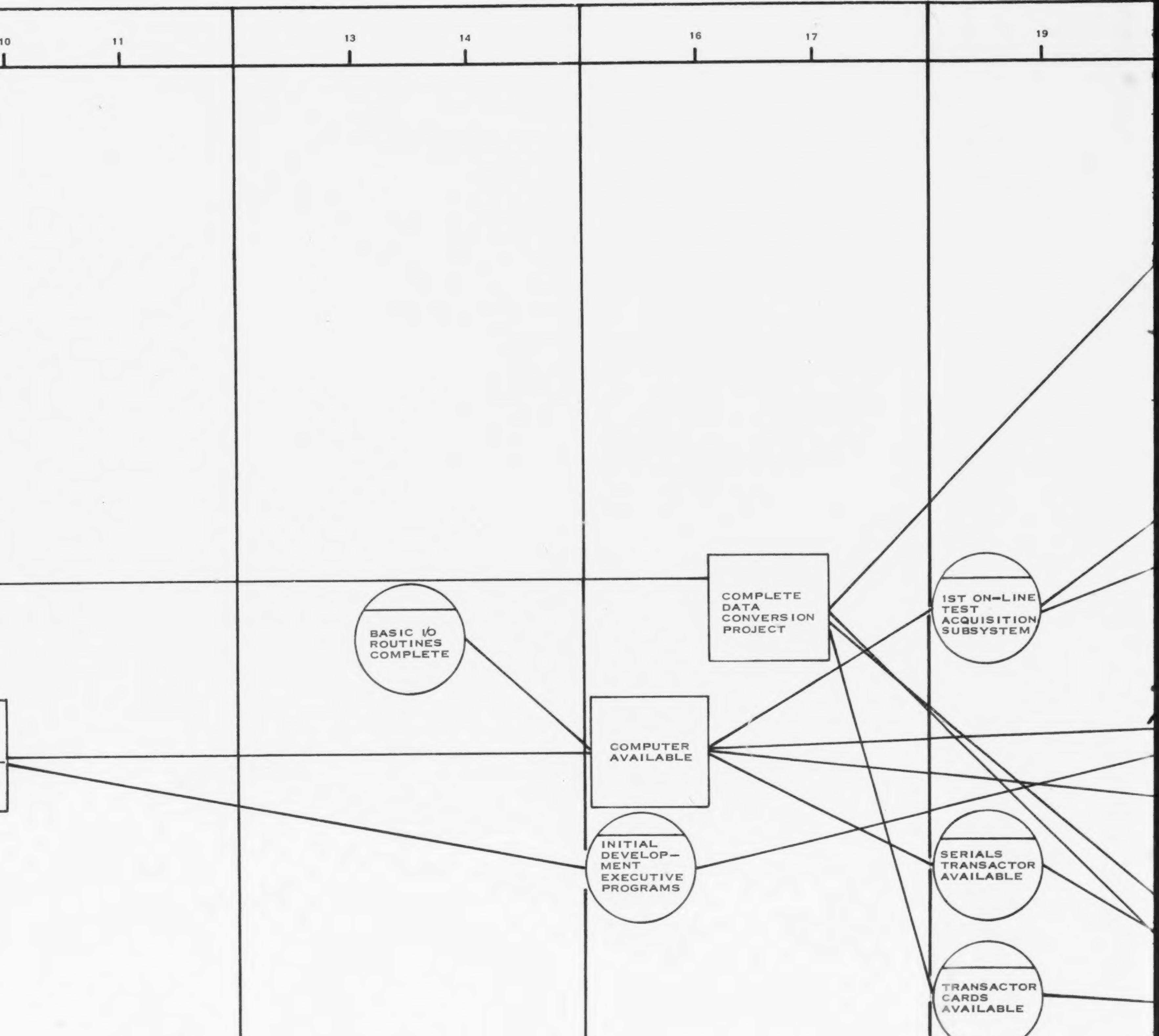
ISSUE RFP FOR DATA CONVERSION
PRELIMINARY FORMAT AVAILABLE
AWARD CONTRACT DATA CONVERSION PROJECT
MPLETE VIEW ASE II
ISSUE RFP IMPLEMENTATION CONTRACT
RECEIVE CONTRACTOR PROPOSALS
AWARD IMPLEMENTATION CONTRACT
CONTRACTOR ISSUE DETAIL DESIGN REPORT
NAL REVIEW & IMPLEMENTATION GO-AHEAD
L REVI & PLEME N GO- EAD
ESTABLISH PRELIMINARY STAFFING ADP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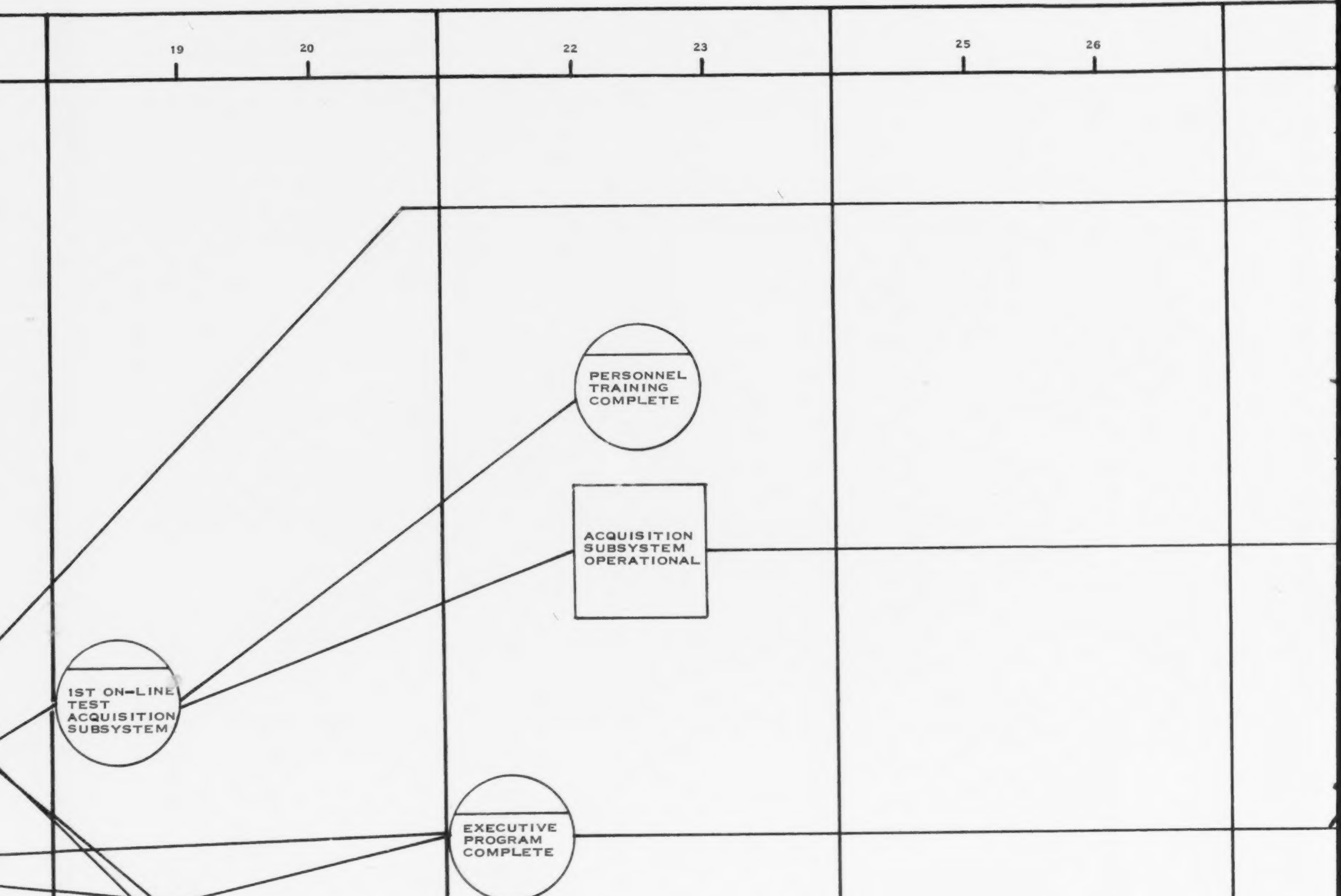
BASIC I/O ROUTINES COMPLETE
COMPLETE DATA CONVERSION PROJECT
1ST ON-LINE TEST ACQUISITION SUBSYSTEM
COMPUTER AVAILABLE
INITIAL DEVELOPMENT EXECUTIVE PROGRAMS
SERIALS TRANSACTOR AVAILABLE
TRANSACTOR CARDS AVAILABLE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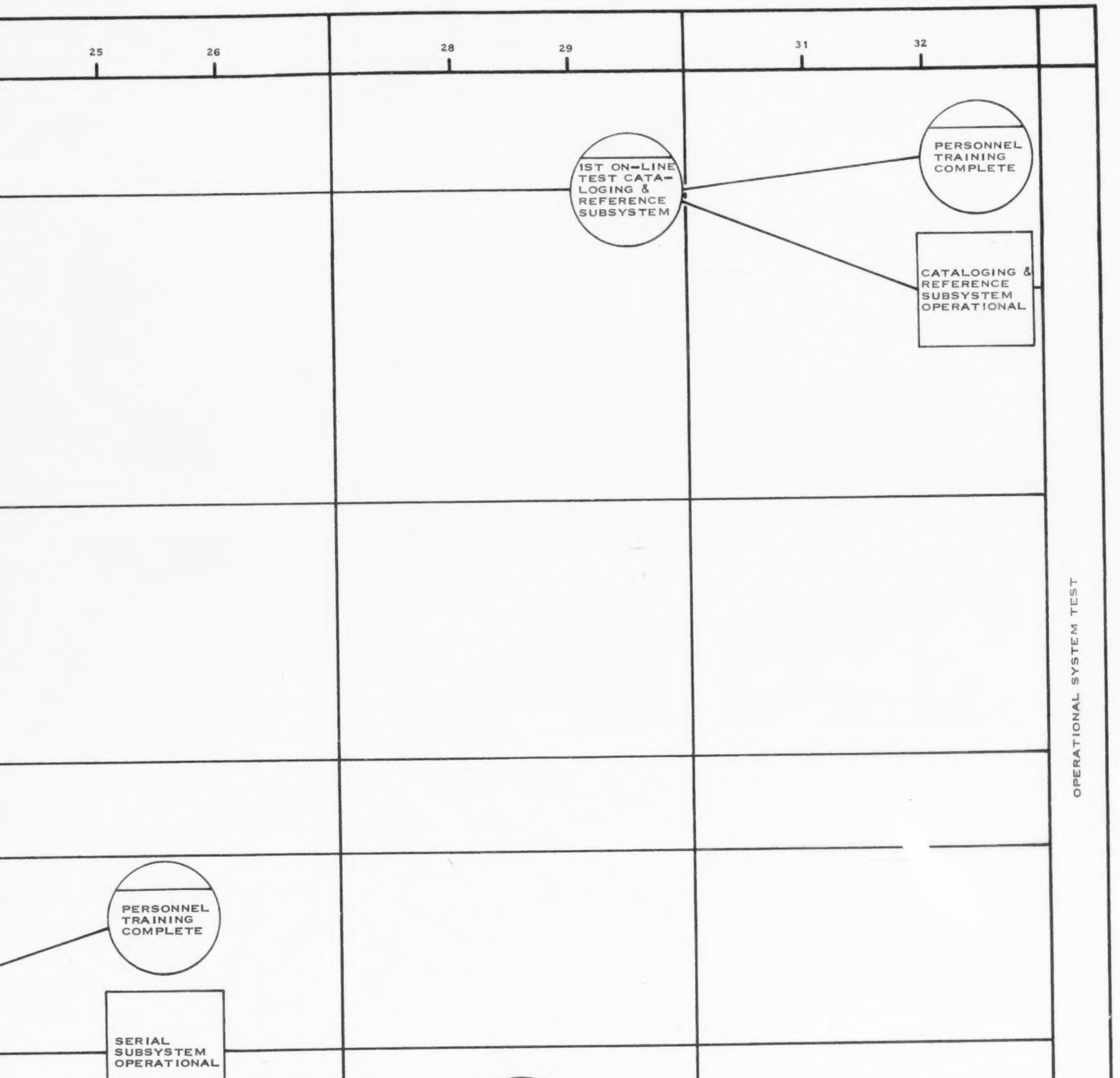
PERSONNEL TRAINING COMPLETE
ACQUISITION SUBSYSTEM OPERATIONAL
1ST ON-LINE TEST ACQUISITION SUBSYSTEM
EXECUTIVE PROGRAM COMPLETE
COMPLETE I/O ROUTINES
SERIALS TRANSACTOR AVAILABLE
PERSONNEL TRAINING COMPLETE
TRANSACTOR CARDS AVAILABLE
1ST ON-LINE TEST SERIAL SUBSYSTEM
SERIAL SUBSYSTEM OPERATIONAL
BEGIN DEVELOP-MENT CIRCULATION DATA BASE
1ST ON-LINE TEST CIR-CULATION SUBSYSTEM

FIGURE 27
PERT Chart
for Implementation
of NAL System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1ST ON-LINE TEST CATALOGING & REFERENCE SUBSYSTEM
PERSONNEL TRAINING COMPLETE
CATALOGING & REFERENCE SUBSYSTEM OPERATIONAL
PERSONNEL TRAINING COMPLETE
SERIAL SUBSYSTEM OPERATIONAL
PERSONNEL TRAINING COMPLETE
1ST ON-LINE TEST CIRCULATION SUBSYSTEM
CIRCULATION SUBSYSTEM OPERATIONAL
OPERATIONAL SYSTEM TEST

such contractual assistance provides the advantage of implementing the system at a rate of progress commensurate with the available funding and/or other priorities determined by NAL. In addition, the use of contractor personnel need not be continued past the point when NAL personnel become fully capable of performing the remaining implementation functions. The flexibility of such an approach will assure rapid implementation and maximum economy of effort.

The estimated capital cost for a fully operational DLCS at a 1973-capability level is summarized in Table 8. It is assumed that implementation will proceed as outlined in the plan detailed in Figure 27, that maximum use of contractor assistance will be made, and that parallel manual operations by NAL will be kept to a minimum. Thus, NAL personnel costs are not included nor are the one-time cost of preparing manual data for inputting to the DLCS. When systems contractors propose specific hardware, a broad range of variables are introduced with respect to performance features. This, coupled with normal variations in pricing for hardware with similar performance, results in a range of overall cost. Even though the details of these differences cannot be anticipated, general criteria for high/low estimates can be determined.

Table 8
Estimated High-Low Implementation Costs

MAJOR COST ELEMENTS	TOTAL COST IN DOLLARS	
	HIGH	LOW
CENTRAL PROCESSOR	855,000	530,000
BULK STORAGE	575,000	470,000
REAL-TIME INTERFACE	1,190,000	1,030,000
SOFTWARE	1,620,000	1,320,000
SYSTEMS ENGINEERING	500,000	200,000
TOTAL	4,740,000	3,550,000

A maximum cost could be incurred from a particular vendor if:

- Disk storage is used for all bulk memory.
- A 20 to 30 percent spare CPU capability is provided.
- Very little software is already developed and included with the hardware.
- The terminals used are more elaborate than required or require special modification.

A minimum cost could be achieved if:

- Low cost bulk storage (e.g., data cell) is used.
- An exact match of CPU capabilities to DLCS requirements is obtained.
- A substantial portion of the control programs are available with the hardware.
- Simple "off-the-shelf" terminals that meet the requirements are used.

The costs are broken down into four major system components plus systems engineering. The cost of systems engineering must be accounted for separately since the four components were priced by adding together individual component costs. Hardware or software prices may encompass all or part of the systems engineering cost. In any case, skilled systems engineering is required to maintain overall functional integrity as individual subsystems are integrated into the DLCS. In addition, the estimated implementation-cost breakdown for cumulative system, shown in Figure 28, provides for the time-phased allocation of funds.

2. SELECTION OF IMPLEMENTATION MEDIA

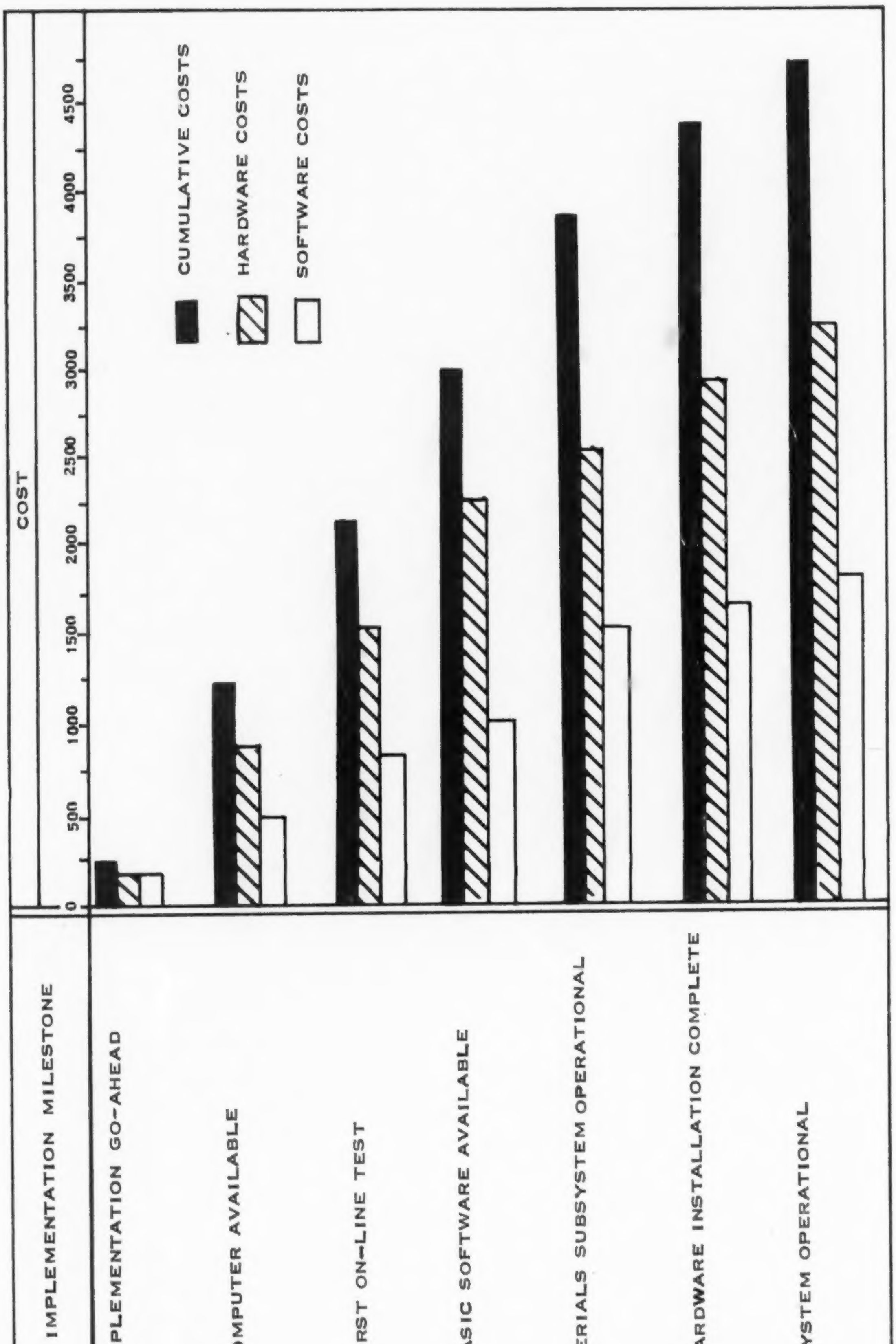
Because the output of this study was designed to provide NAL with a functional system design, several areas remain that can only be detailed with respect to specific hardware elements. These fall into the two following categories:

(1) Hardware and software specification and costs which will ensure the achievement of creative and economical solutions to the library problems discussed in this report.

(2) Identification of a set of detailed operational relationships/ procedures between the contractor's proposed hardware/ software and the library functions specified in this report.

The implementation contractor must be concerned, as a first step, with specifically detailing the interrelation between his hardware and the system design. The purpose of this 3-month task is to prepare a detailed analysis of the way in which his specific hardware/ software configuration will provide the means for a facile, efficient implementation of the library functions.

FIGURE 28
Estimated Implementation-Cost Breakdown for Cumulative System



The product of the effort will be presented to NAL for its approval and/or revision at the end of the third month. This detailed design report will describe the data file structure, record layout, file organization, and procedures for updating data files within the context of a specific hardware/software configuration. It will provide the final design details, any modifications to hardware and software specifications, firm delivery and implementation schedules, and any requisite adjustments to hardware and software costs. Upon approval of his plan, the contractor can proceed with hardware deliveries and the writing of library programs. Thus, an orderly evolution is assured to system documentation, preparation of training manuals and programs, and the design and execution of product assurance tests.

3. ORGANIZATION AND PERSONNEL REQUIREMENTS

The introduction of an inventory control system into the current NAL organization will require that certain operational procedures be changed and that there be some organizational modifications. Overall responsibility for the development and operation of the system must be vested in a single organizational unit of NAL. This unit must possess two major characteristics if it is to be fully responsive to the demands of automation. First, it must have the support of top management and should be located at a level in the organization that automatically assures it authority commensurate with its responsibilities. Second, this organizational unit must be provided with enough technically competent personnel to pursue vigorously the development and implementation of the system.

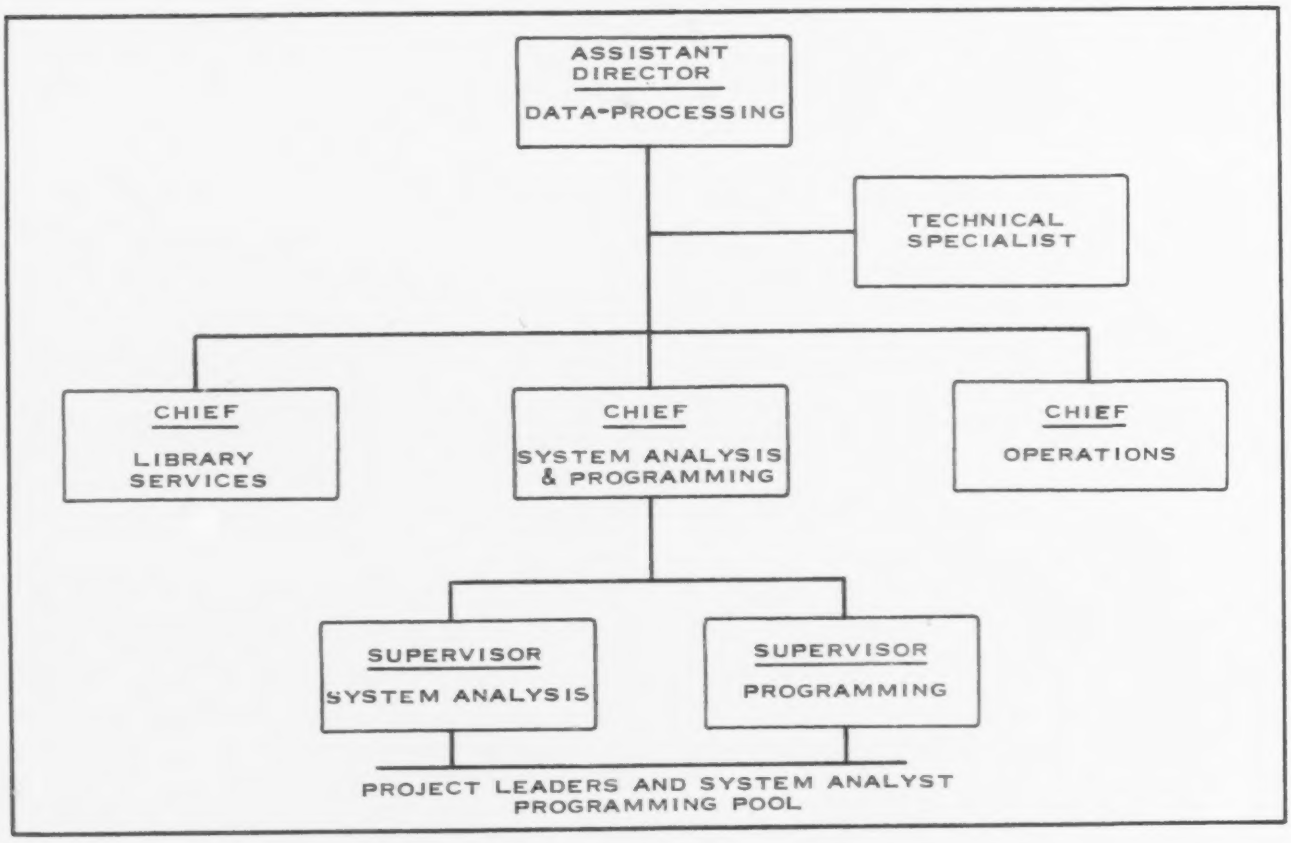
A recommended organization plan for the proposed system operations appears in Figure 29. It shows an Assistant Director in charge of Data-Processing who will have comprehensive responsibility for effective systems operations and data-processing services at NAL. The Assistant Director should report directly to the Office of the Director.

Three major organizational groups will report to the Assistant Director. These groups will be formed on the basis of the three principal responsibilities of data-processing unit in a national library: Library Service, Systems Analysis and Programming, and Operations

(1) Library Service

This group will be responsible for research on data-processing equipment and technology and for the planning for their use within NAL. These responsibilities include formulation of standards, exercise of project control, surveillance

FIGURE 29
Recommended Organization Plan
for Proposed System Operations


ASSISTANT DIRECTOR
DATA-PROCESSING
TECHNICAL SPECIALIST
CHIEF
LIBRARY SERVICES
CHIEF
SYSTEM ANALYSIS & PROGRAMMING
CHIEF
OPERATIONS
SUPERVISOR
SYSTEM ANALYSIS
SUPERVISOR
PROGRAMMING
PROJECT LEADERS AND SYSTEM ANALYST PROGRAMMING POOL

and control of methods and procedures, and provision of assistance to branch libraries. This group will also provide external coordination and planning of data-processing activities and interfaces.

(2) Systems Analysis and Programming

This group will be responsible for appraising the detailed, system-implementation requirements on an NAL-wide basis, for systems design, and for specification and coordination of programming. They will implement proposed data-processing applications and will determine the operation of each.

(3) Operations

This group will be responsible for scheduling, for control and operation of data-processing equipment, and for assuring the most effective use of computers and other data-processing equipment.

Within the Systems Analysis and Programming group, there will be supervisors whose principal ability is oriented toward the library field so that specialized knowledge is available to meet specialized requirements. Assisting the supervisors, however, will be a pool of project leaders and programmers with a broad variety of interest and experience. The staff members should be assigned on a project-by-project basis (e.g., acquisitions, serial record and control, etc.) to permit the formation of the data-processing and project teams best able to meet the requirements of each project.

Assistance for the Assistant Director will be provided by the staff position of Technical Specialist. He will be responsible for the technological state of the art, for equipment research, and for analysis of special equipment requests.

Table 9 indicates the number of personnel and the skills required for each of the positions proposed for the new organization. (See Appendix E for detailed job descriptions.) The small number of personnel proposed for the new group indicates that there is no place within the new organization for trainees. To be effective, even the most specialized, system-design employee will require 5 to 10 years of solid and varied professional experience in automatic data-processing and related library fields. Only in the programming group can inexperienced or junior personnel be employed.

The teams will deal with problems so complex that the personnel working on these problems must have a wide range of skills.

Table 9
Personnel Requirements for Automated System

OPERATING UNITS	PERSONNEL					
	PRESENT			RECOMMENDED		
	NUMBER	GRADE	SKILL	NUMBER	GRADE	SKILL
LIBRARY SERVICE	–	–	–	3	13	LIBRARY SCIENCE-ADP
SYSTEMS ANALYST	2	13	PROGRAMMING	4	13	ADP-ENGINEER
PROGRAMMING	2	9-11	PROGRAMMING	5	9-13	PROGRAMMING
OPERATION	–	–	–	5*	9-13	MACHINE
TOTAL	4			17		

*ONE SUPERVISOR AND FOUR OPERATIONAL PERSONNEL.
SECOND SHIFT WILL HAVE ONLY FOUR OPERATIONAL PERSONNEL.

Only broadly experienced and very able personnel can accomplish work on this level in a reasonable length of time and within acceptable limits of manpower strength.

Pay levels should meet both industrial and civil service criteria, if possible. The pay grades suggested are generally comparable to industrial rates for above-average personnel doing automatic data-processing (ADP) system design and programming of the complexity necessary for the NAL system.

To attract relatively young, executive-grade, ADP-system specialists from private industry, the civil service grade structure will have to be high enough so that these employees can be placed in step categories 1 through 4, where annual salary increases are routine. Specialists such as these are accustomed to frequent and substantial salary increases and will be favorably impressed by a personnel policy that provides them with reasonable assurance that they will not swiftly fall behind their colleagues in industry during the first few years of Government service and before they can make a mature judgment on whether to remain in civil service or to return to industry.

Eventually, personnel of the required high caliber can surely be developed from within the civil service; however, it is highly doubtful that the necessary numbers of interested and suitable candidates can be immediately won from the very rewarding assignments they presently hold elsewhere in the Government service.

4. ORIENTATION AND TRAINING

The requirements for orientation and training apply to the following three categories of personnel:

(1) New ADP technical personnel who are brought into the NAL organization to implement and operate the proposed system

(2) Existing library and management personnel

(3) Contractor system-design personnel who would be responsible for system implementation.

New ADP personnel, including in-house and contractor personnel, will need a careful grounding in the NAL organization, mission, operating procedures, and interfaces. This is to ensure that implementation and operation of the ADP system will be conducted so that maximum benefit will be realized by all user organizations while the transition from manual to ADP operations is as smooth as possible. A well-designed series of orientation lectures, detailed in Table 10, is recommended.

Table 10
Orientation Lectures

Subjects	Time
Definition of Goals and Objectives of NAL	10 min
Discussion of Total System—Organizational (Automated, Administrative, Library)	30 min
Inputs and Outputs/Display of Data	60 min
Storage of Data—Hardware and Software (brief discussion)	30 min
Organization of Data Conversion (files, etc.)	30 min
System Breakdown by Function (Acquisitions, Cataloging, Serials, Circulation, Reference)	60 min
. User Requirements	
. Inputs and Outputs	
. Standardization	
. Man-Machine Interaction (Equipment)	
. Data Preparation	
. Data Reduction and Analysis	
. Decision Ability	
Total System Interactions	30 min

Existing operational and management personnel will generally require a concentrated, ADP-system, training effort in addition to the orientation series. Such training is critical to the success of the system, from the standpoint of both acceptance and realization of maximum benefits. Concentrated ADP-system training will engender understanding and support from both management and staff during system implementation and during the period when problems are encountered in initial system operation. It is, therefore, very important that an appropriate, formal, training program be developed and conducted during implementation.

Senior management personnel may need only four or five 1-hour seminars on ADP and its management implications; operational staff members should receive a more complete training in operational programming. The previously presented U.S. Department of Agriculture course, "Automatic Data-Processing for Federal Executives," should fulfill this latter requirement in conjunction with subsequent on-the-job training in which these staff members can observe all elements of system operation. Initial on-the-job training can be effectively achieved by direct participation in system development and testing.

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APPENDICES

APPENDIX A

SERIAL TITLES RECEIVED BY NAL—LANGUAGE DISTRIBUTION

For the proper design of an effective serial check-in system, a knowledge of the distribution of languages and their printed forms as used in the serials acquired by NAL is needed. Since no such statistics are available, nor is any up-to-date catalog of current serial titles, a study was made on samples of the List of Serials Currently Received in the Library of the U. S. Department of Agriculture as of July 1, 1957, Miscellaneous Publication 765, July 1958. The validity of such a study can be justly questioned on the following basis:

- Errors associated with sampling
- Changes since 1957
- Equation of title frequencies with volume distributions of issues.

The list contained approximately 23,000 titles, and the sample was about 580 titles, or 2.5 percent taken at random. Although this sample is too small to measure with accuracy categories of less than 5 percent, it will indicate their presence and will give a rough measure of their frequency. This is all that is needed for the design, which must in any case be modified after implementation when more accurate data will be readily available.

The effects of changes since 1957 are not so easily identified. It is assumed that, while the specific serials being acquired have changed, the distribution has not. There are two reasons why this may not be true:

1. There has been a rise in nationalism with a corresponding tendency to use native languages.
2. There has been a shift in NAL emphasis, especially toward Russian and oriental sources.

The first trend is not a severe handicap because most nations use a latinized alphabet (with the possible major exception of Israel where the trend is to Hebrew). The second trend is important, however, and should be provided for in the design by allowing for higher frequencies than this study found.

The equation of title frequencies with volume distribution of issues, while unavoidable, does bias results. The direction of this bias, however, is probably toward a larger-than-actual frequency for some foreign languages because so many of the foreign titles are government annuals or similar items that are published infrequently.

1. PROCEDURE

The sample consisted of the first entry on each page of the list. This is essentially every 40th entry and, for a multilingual alphabetic listing, should be essentially random. The language recorder was, when identifiable, the language of the title. When this was not possible, the language most common to the place of publication was recorded. In some cases, a translated title was used in the listing; this was indicated by the notation of a language in parentheses. In these cases, it was assumed that the title appeared on the serial in the language noted. None of the actual serials was examined to see if a translated or transliterated title was also present, which is often the case.

2. RESULTS

The following categories that are most significant for a sorting and identification scheme are:

.	English	68.7%
.	Non-English with Roman alphabet	28.5%
.	Cyrillic	2.4%
.	Nonalphabetic	0.3%

The following breakdown of the number of occurrences of each language and group of languages is more detailed.

Language	Number	Percentage
English	399	68.7
German	38	6.5
French	28	4.8
Spanish	22	3.8
Dutch and Afrikaans	18	3.1
Italian	17	2.9
Portuguese	10	1.7
Scandinavin		2.8
Danish	5	
Swedish	4	
Finnish	4	
Norwegian	3	
East European - Roman		1.6
Hungarian	3	
Yugoslavian[1]	3	
Czechoslovakian	2	
Polish	1	
Oriental - Roman		0.9
Japanese	4	
Chinese	1	
Oriental - Nonalphabetic		0.3
Japanese	2	
Cyrillic		2.4
Russian	13	
Bulgarian	1	
Other - Roman		0.5
Indonesian[2]	2	
Turkish	1	

3. COMMENTS

It should be noted that this was a study of the languages of the titles and not of their origins. It has been widely quoted that over

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[1] Since all three publications were from Belgrade, it was assumed they were latinized.

[2] Although both these titles were in Dutch, it is assumed that by now they either have disappeared or have been converted to Bahusa Indonesian, which is latinized.

50 percent of the serials at NAL are foreign. This is probably true; but 70 percent of the titles are in English. The most surprising result is that less than 3 percent were of non-Roman alphabets or were nonalphabetic. This differs considerably from the 20 percent figure that is often quoted. Thus, the following conclusions may be drawn:

- A knowledge of the English language enables straightforward processing of 70 percent of the incoming serials.
- A knowledge of the Roman alphabet enables, with graphical aid and notes, processing of 97 percent of the incoming serials.
- Even though the time spent per item in identifying non-Roman items may currently be high, it does not represent an appreciable percentage of the total serial-processing workload.

APPENDIX B

SYSTEM USAGE STATISTICS

The very nature of automation lends itself to the acquisition and accumulation of statistical data on system usage. These statistical data are available for presentation in varying degrees of detail, format, and frequency, thereby permitting administrative review of past and current operating trends in order to plan changes in the operational environment.

The DLCS design has included this feature by virtue of the content and structure of the data base. Noted by function in this appendix are some of the statistics/tabulations that are acquired and accumulated within the recommended system.

Retrieval of sets of numbers pertaining to these categories would, in itself, provide a somewhat boring and ineffective mode of operation for the system. The capability to summarize, correlate, associate, and combine data from various categories to present a concise overview of a specific operation is a strong advantage of the system. Specially formatted data can illustrate trends in usage that from a pure numerical viewpoint may not be immediately apparent.

The optimum use of administrative information, as recommended in this report, requires close participation by the groups served by the system. In addition to describing the uses for the data, it is essential that these groups plan and experiment with formats and frequencies in order to develop meaningful and cost-effective reporting techniques.

It is recommended that NAL organize and pursue a program that will develop a data-reporting system for administrative purposes in keeping with the capabilities of the DLCS.

1. ACQUISITIONS FUNCTION

Number of items requested as gift/purchase/exchange

Number of items requested for Bee/Law/PIC/etc.

Number of items received as gift/purchase/exchange

Number of items received for Bee/Law/PIC/etc.

Total budget allocated/committed/spent

Amount spent per country

Number of claim notices sent

Number of cancelled orders

Total amount of blanket order money committed/spent

Number films/microforms ordered/received

Amount spent on films/microforms

Number of items ordered/received by language and/or country

Number of new serial titles ordered/received

Dollars spent on new serial titles

Number of items ordered/received per source

Dollars spend/committed per source

List of outstanding orders

Gift/exchange source list

Blanket order dealers list

2. SERIAL RECORDS AND CONTROL FUNCTION

Number of issues received/checked-in

Number of titles received

Number of titles received/language/country/subject

Number of titles received as gifts exchanges/purchases

Number of claim notices sent

Number of titles renewed
Number of titles routed/location
Number of duplicate titles received
Number of titles/volumes bound
Number of titles ready for binding
Total dollars spent on renewals
Total dollars spent on binding
Number of titles dropped/discontinued/etc.
Number of new titles received
Number of title changes/publisher/etc.
Number of items handled by a special checker
Routing list
Language and/or country list
Subject list
Holdings list
Renewal list
Claims list
Gift and exchange list
Duplicate copy list
Purchased list
Bindary list
New titles list
Publisher list
Titles dropped/discontinued/etc.

3. CATALOG AND RECORDS QUALITY CONTROL FUNCTION

Total number of items cataloged
Number items cataloged by language/subject

Number of new serial titles cataloged
Number of permanent records changed
Number of authorities created
Number of items cataloged for others

4. REFERENCE FUNCTION

Number of request by title/author/accession number
Number of request for a translation
Number of request for serial/monograph
Number of short bibliography requests
Number of citation printouts
Number of phone/mail requests
Number of unanswered or unfulfilled requests by subject/author/title/etc.

5. CIRCULATION CONTROL FUNCTION

Number of items charged out per period of time
Number of items/pages copied
Number of serial issues/titles charged out
Number of monographs/films/etc. charged out
Number of items missing
Number of borrowers
Number of status reports sent
Number of items routed
Number of items on reserve
Number of items at the bindary/the B of A/on indefinite loan

Borrower list
List of titles photocopied
List of items missing
List of items on reserve
List of items charged to a borrower
List of items routed.

APPENDIX C

ABSTRACTING SERVICES

A variety of abstracting services have arisen in many fields. One of the oldest of these is The Chemical Abstracts Service (CAS), a Division of the American Chemical Society. It has been providing chemical and chemical engineering information services since 1907. These services have grown to include abstracts, indexes to abstracts, specialized field abstracts, chemical compound indexes, periodical listings, and other supplemental services. Certain of these services are available on magnetic tape as well as in formatted documents. BioSciences Information Service (BioSIS) is another such organization that provides a biological information through the publication of abstracts and indexes. Both organizations function primarily to provide a current awareness program of considerable breadth. As such, their published documents belong in the NAL collection.

As to their value as working tools for the NAL staff, these documents lend themselves primarily to an intellectual search such as would be conducted by reference personnel and do not provide direct support to a document control system.

CAS currently provides several magnetic tape services. The most comprehensive of these is CA Condensates, which contains a skeleton form of each abstract in Chemical Abstracts. The specific content of each entry includes the following:

- Title of paper, patent, or report
- Name(s) of author(s)/assignee(s)
- Bibliographic citation
- CA abstract number
- Index terms.

The search may be executed by using one or more of the following:

- Words (complete or fragmented)
- Compound names
- Author(s) name(s)
- Journal titles.

The retrieved output will be the skeleton entry as previously defined, exclusive of index terms. A more in-depth magnetic tape service, Basic Journal Abstracts, provides actual abstracts from 35 chemical and chemical engineering journals. The individual data blocks contain the following:

- Title of paper
- Name(s) of author(s)
- Bibliographic citation
- BJA abstract number
- Complete abstract.

The search capability is similar to that of CA Condensates, with the addition of molecular formulas as a possible input. The output is identical to that of CA Condensates (except for BJA abstract numbers instead of CA abstract numbers). Thus, it is necessary to go to the printed publication to read the abstract; its sole function on the tape is that of a collection of words and names that may be searched.

BioSIS provides bibliographic and index information on magnetic tape corresponding to the printed issues of Biological Abstracts and BioResearch Index. This service, known as BA-previews, provides the following:

- Abstract number
- Title
- Index terms
- Author(s) name(s)

- Various codes
- Journal reference.

The search profile may contain one or more of the following elements:

- Word(s) from title
- Index terms
- Author(s) name(s)
- Journal name.

Weighting of terms is allowed.

It is apparent that these tapes lend themselves to very broad searches, especially on a topical basis. They lead either to a printed abstract or to the identity of the primary document. As an in-house capability for searching, these tapes could no doubt be implemented by using the same computer that is used for the inventory system; but its function would be essentially oriented toward user service.

Both CAS and BioSIS are looking at remote terminal applications, but neither has specific plans for implementation. CAS expects independent information centers to provide such a service by using the CAS tapes. BioSIS makes no predictions.

APPENDIX D

DATA BASE ELEMENTS

NAL Data Elements

CONTROL DATA

Arbitrary Numbers

NAL Tag		MARC Tag
101	Accession number	019
102	L. C. card number	010
103	Nat. bibliography number	011
104	Standard book number	012
105	PL 480 number	013
106	Report number	---
107	Source Accession number (AD, PB, N numbers)	---

Knowledge Numbers

NAL Tag		MARC Tag
111	NAL call	070, 090
112	L. C. call	050
113	NLM call	060
114	BNB classification	020
115	Dewey decimal classification	030
116	Universal decimal classification	080
117	Contract number for reports	---

Location and Administrative

NAL Tag		MARC Tag
121	Current location/status code	---
122	Order number	---
123	Requisition number	---

NAL Tag		MARC Tag
Circulation		
131	Current borrower	---
132	Data loaned	---
133	Date due	---
134	Date overdue notice sent	---
135	Identification of borrowed item (copy number or serial volume issue, etc.)	---
ENTITIES		
Authors		
211	Personal name	100
212	Corporate name	110
213	Conference or meeting	111
214	Corporate name with form subheading	120
215	Editor	700, 710
216	Illustrator	700, 710
217	Translator	700, 710
218	Published under pseudonym of	---
Series Information		
221	Personal name as note	400
222	Corporate name as note	410
223	Conference as note	411
224	Personal name as series added entry	800
225	Corporate name as series added entry	810
226	Conference as series added entry	811
227	Series untraced or traced differently	490

NAL Tag		MARC Tag
Subject Entries		
231	Personal name as subject	600
232	Corporate name as subject	610
233	Conference or meeting as subject	611
234	Corporate name with form subheading	620
235	Geographic location	651, 652, 657
236	Proper name not capable of authorship	653
Other Added Entries		
241	Personal name	700
242	Corporate name	710
243	Conference or meeting	711
244	Corporate name with form subheading	720
245	Proper name not capable of authorship as added entry	753
TITLE		
Titles of Works		
301	Exact title if Roman	240
302	Uniform title	200
303	Transliterated title	210
304	Translated title	220
305	Short title	---
306	Sub title	---
307	Title used as main entry	130
Series Titles		
310	Series title	408, 418

NAL Tag		MARC Tag

Titles as Added Entries

321	Title as subject	608, 618, 628
322	Title as other added entry	708, 718, 728
323	Title traced differently as added entry	440

DESCRIPTIVE

Imprint*

411	Publisher	261
412	Place of publication	260
413	Imprint date	262
414	Pagination	300
415	Height	300
416	Illustration statement	300
417	Form of item	---
418	Edition statement	250
419	Number of copies (if more than one)	---

Language

421	Language(s) of item	---
422	Translation from	---
423	Abstracts or summaries in (language)	---
424	Accession of translations or original language edition	---

---

* If more than one publisher and/or place of publication is present, the one representing the most logical source within the U.S. is used. The date associated with that location is used for the imprint date.

NAL Tag		MARC Tag
Notes		
431	General notes	550
432	Abstract	560
433	Contents note	520
434	Bibliography note	500
436	Fixed format portion of MARC II	---
437	Limitations	540
438	Security classification	---
439	Serial data change note	---
440	Dissertation note	510
441	Bound with	530
SUBJECT		
Subject Authorities		
501	NAL Agricultural/Biological vocabulary	690, 670
502	NAL subject category number	---
503	NLM subject headings MeSH	---
Other Subject Terms		
511	Geographic names	651
512	Political jurisdiction	652
513	Topical subject	650
514	Period subdivision	656
SERIAL DATA		
Publication Pattern		
610	Frequency codes	---
614	Frequency note (if needed)	---

NAL Tag		MARC Tag
Publication Pattern (cont'd)		
611	Most significant division	---
612	Least significant division	---
613	Intermediate division, if present	---
614	Period in days between issues before claim alert notice	---
615	Date of last holdings entry in sequence	---
616	Date of an out-of-sequence receipt	---
617	Period in days after an out-of-sequence receipt before claim alert notice	---
Binding		
621	Number of least significant units to be bound together	---
622	Free text binding instruction, including how to handle indexes	---
623	Free text statement on existence of supplements	---
624	Free text statement on indexes	---
630	Accession number(s) of separately cataloged supplements	---
Holdings		
641	Fixed format holding - inclusive	---
642	Fixed format holdings - detailed units - inclusive dates	---
643	Fixed format holding - individual units with single dates	---
Title History		
651	Date and former title's accession number	---
652	Date and new title's accession number	---
653	Date and accessions of serials merged to form this one	---

NAL Tag		MARC Tag
Title History (cont'd)		
654	Date and accession number of a serial that split to create this one accession number(s) of other results of split	---
655	Date and the accession number of result of merger and the accession number(s) of title that merged with this one	---
656	Date and accession number(s) of titles that resulted as a split of this one	---
ADMINISTRATIVE AND STATISTICAL		
Time		
711	Time selected	---
712	Time ordered	---
713	Time received	---
714	Time added to shelf	---
Use		
721	Number of times requested	---
722	Number of times data accessed	---
723	Number of times loaned	---
724	Number of times reproduced (in full or part)	---
725	Number of times rebound	---
726	Number of times lost	---
727	Number of times replaced	---
728	Route code	---
Acquisition		
731	Gift, purchase or exchange	---
732	Purchase price—U. S. dollars	360
733	Cited price—any currency	350
734	Vendor/source code	---
735	Bibliographic price	---

NAL Tag	MARC Tag
Uncategorized MARC Elements	
741 Legend	002

APPENDIX E

JOB DESCRIPTIONS

ASSISTANT DIRECTOR, DATA-PROCESSING

Reports to:	Director, National Agricultural Library.
Supervises:	Chief, Systems Analysis and Programming; Chief, Library Services; and Chief, Operations.
Basic Function:	Plan, administer, and evaluate NAL-wide data-processing activities.

Major Responsibilities

1. Determine scope, extent, and orientation of NAL data-processing services.
2. Establish budget for data-processing equipment and personnel, and control expenses.
3. Assure full and accurate reporting on equipment use; analyze present and potential use factors and project future requirements.
4. Investigate feasibility of recommended applications.
5. Review and evaluate systems design and programming efforts on major data-processing projects.
6. Develop operational policies to cover data-processing services.
7. Provide a data-processing facility with appropriate and well-balanced equipment and fully qualified personnel to match NAL requirements.

8. Develop and maintain long-range plan for NAL data-processing activities.

9. Provide central point for all external coordination and planning of systems within NAL.

10. Be responsible for all data-processing implementation and cost justification of this.

Education

Should hold an advanced degree in Engineering or Mathematics or, preferably, a combination of these. In addition, should have received comprehensive formal training in computer techniques and should have acquired a broad knowledge of present and evolving computer and library technologies.

Experience

Has served as Director or Assistant Director of a medium-sized to large data-processing installation; has breadth and depth of experience in application of computers to library automation projects and programs; has been responsible for systems analysis and design as well as programming activities.

CHIEF, LIBRARY SERVICES

Reports to:	Assistant Director, Data-Processing
Supervises:	Library Services staff
Basic Function:	Develop plans and programs for the application of data-processing equipment, techniques, and technology to NAL's library programs; evaluate results.

Major Responsibilities

1. Evaluate existing programs and projects in data-processing for effectiveness.

2. Initiate and define all future automation projects and the implementation of these within NAL.

3. Working with appropriate functional staff members, be responsible for determining the way in which non-automated techniques and methodologies can be used most effectively within the library.
4. Develop the long-range plans for data-processing use within NAL.
5. Be responsible for data-processing research and technology.
6. Serve as liaison between the library staff and the data-processing service activities of NAL.

Education

Advanced degree in Engineering or mathematics with course work in Library Science. Formal training in computer and library techniques is required unless experience is sufficiently intense.

Experience

Has served as Director of Data-Processing activities at the university or national level; has worked with computers and has gained an understanding of machine capabilities and limitations; has a complete and extensive understanding of libraries and library science.

CHIEF, SYSTEMS ANALYSIS AND PROGRAMMING

Reports to:	Assistant Director, Data-Processing
Supervises:	Systems Analysis supervisor, Programming supervisor
Basic Function:	Investigate and determine feasibility of system design, programming, and maintenance of all NAL's data-processing systems.

Major Responsibilities

1. Serve as primary contact with library staff concerning the investigations into areas in which automated techniques can be applied.

2. Investigate in detail the feasibility of suggested applications and determination of associated costs.

3. Establish time and dollar budget for approved projects.

4. Assign personnel to each project.

5. Systematically review and evaluate the effectiveness of the systems that are being developed and the programming efforts.

6. Determine, with Assistant Director, Data-Processing, the processing schedules to be met.

7. Review programs that have been implemented to ensure that they meet requirements.

8. Develop a long-range work plan for the conduct of systems and programming work that allows flexibility for short-term service requests.

9. Provide major contract supervision in the area of systems design and implementation for current and future NAL automation projects.

Education

At least a B. S. degree in Engineering or Mathematics; preferably, an advanced degree with a combination of the above areas of concentration. Formal education in programming the type of computers installed at NAL.

Experience

Director of a systems and programming effort for library applications or intensive experience with information-retrieval systems analysis and programming efforts.

CHIEF, OPERATIONS

Reports to:	Assistant Director, Data-Processing
Supervises:	Operations staff

Basic Function: Schedule and control data-processing equipment operations to provide most effective use of equipment and facility requirements of NAL.

Major Responsibilities

1. Establish standard operating practices for computer installation.
2. Schedule computer operations.
3. Provide additional applications to be used for load-balancing purposes.
4. Provide computer availability lists for outside users.
5. Develop a schedule of charges for data-processing equipment use.
6. Collect data and prepare reports and forecasts on equipment utilization.

Education

B. S. degree, preferably in Engineering or Mathematics. Formalized course work in operation of punchcard equipment and computers.

Experience

Manager of operations of a computer installation oriented toward information storage and retrieval.

SUPERVISOR, SYSTEMS ANALYSIS

Reports to: Chief, Systems Analysis and Programming

Supervises: Project leaders and system analysts while on assignment.

Basic Function: Investigate feasibility and control system design of NAL automation projects.

Major Responsibilities

1. Determine feasibility of proposed data-processing applications.
2. Estimate dollars and time involved in the project or application.
3. Present findings to Chief and to appropriate operating personnel.
4. Budget and control the system design effort for multiple projects.
5. Participate in the implementation of new systems and/or projects.
6. Coordinate operating schedules with present workload of data-processing group.
7. Evaluate implemented systems for effectiveness.

Education

B. S. degree in Engineering or Mathematics and formalized training in computer programming; library experience preferable.

Experience

Systems design and programming experience, preferably for nonprofit organization.

SUPERVISOR, PROGRAMMING

Reports to: Chief, Systems Analysis and Programming

Supervises: System programmers while on assignment

Basic Function: Control and programming of projects

Major Responsibilities

1. Estimate dollars and time involved in programming per project.

2. Present findings to Chief and to appropriate operating personnel.

3. Budget and control programming efforts for multiple projects.

4. Participate in the implementation of new systems.

5. Coordinate programming schedules with present workload of data-processing group.

6. Evaluate implemented systems for programming effectiveness.

Education

High school graduate, preferably with at least 2 years of college-level work. Formal training in programming and at least 5 years practical experience in information storage and retrieval systems.

APPENDIX F

GLOSSARY

This glossary is intended to acquaint the reader with the terms used in this report to describe the equipment and computer programming aspects of the system.

The library terms used to define the functions and operation of the system are in accordance with the following documents:

- American Library Association. Anglo-American Cataloging Rules. Chicago: American Library Association, 1967.
- Thompson, Elizabeth A. A.L.A. Glossary of Library Terms. Chicago: Amercian Library Association, 1943.
- U. S. Department of Agriculture, National Agricultural Library. Organization Charts, 1963. Prepared by Classification and Organization Branch, Division of Personnel, OMS.
- U. S. Department of Agriculture, National Agricultural Library. Report of Task Force ABLE: Agricultural Biological Literature Exploitation. Washington, D. C.: Government Printing Office, 1965.

Access, Random

Pertaining to the process of obtaining information from or placing information in storage where the time required for access to the storage location is independent of the location most recently accessed. In practice, memory devices such as disk files are termed random access even though the access time is partly dependent on the previous location used. In this context, random access is in contrast to serial access, in which access is dependent on the position of the storage location in a set of storage locations that must be processed serially. An example of a serial-access storage medium is magnetic tape.

Access Time

Time required to read or write in a particular location. Frequently used to mean average access time for all locations in a particular storage unit.

Alphanumeric

A coding system capable of representing alphabetic characters, numerals, and other symbols.

Batch-Processing

Collection of data over a period of time for sorting and processing as a group during a particular machine run.

Bibliographic Record File

The data associated with each cataloged item at NAL and ordered by accession number.

Bit

A binary digit; hence, a unit of data in binary notation; abbreviated from binary digit.

Buffer

A device used to compensate for differences in speed between two devices to permit them to operate together by temporarily storing information.

Card Punch

A device for punching data onto cards. Equipments vary from hand punches to high-speed punches for magnetic-tape-to-card conversion or direct output from the processor.

Central Processing Unit (CPU)

The device containing the arithmetic unit, control unit, and main memory. Also referred to as the main frame.

Data Base

The entire mass of stored machine-readable data accessible from a multiplicity of terminals.

Disk, Magnetic

A rotating metal disk having a magnetized surface on which information may be stored. A disk file is an auxiliary device containing an array of disks and read-write heads mounted on arms, which read and write on the disk surfaces.

Display

Visual representation of data on a console, in a printed report, or by other means.

Element

The individual pieces of data (denoted by a tag) that in aggregate form a record.

Files

Strings of data ordered by a single tag or by a group of hierarchically related tags. A single file will, in general, contain both permanent and intermediate data.

File Index

Selected data elements with their associated accession numbers or surrogates, ordered alphanumerically to provide required entry to the bibliographic record file.

Formatted Retrieval

The fetch of a selected set of data elements from a variety of memory location. The fetch is initiated by identifying the specific format and (directly or indirectly) the desired accession number.

Intermediate

Data that are intrinsically transient in nature or that are being accumulated prior to review and subsequent transfer to a permanent category. These data are similar in form to the permanent data base and are stored in partially protected locations subject to read/write capabilities from selected terminals.

Interrupt

Stopping the normal operation of a program to recognize and/or perform a different operation, after which control may be resumed at the point of interruption.

Off-Line Equipment

Equipment not connected directly to the central processor, but working through an intermediary device.

On-Line Equipment

Equipment connected directly to the central processor to furnish or receive data.

On-Line, Real-Time

An on-line, real-time system combines two kinds of activity: (1) an on-line system receives information about current activity as soon as it occurs, and (2) a real-time system gives answers to a continuing problem for a particular set of input values while those values are still usable. A computer is on-line because the computer user interacts directly with the computer and is real-time because the computer gives answers immediately.

Permanent Data

Data that have been reviewed by competent authority and transferred to a fully protected storage location; characterized by a read-only capability from most terminals.

Primary Record

The group of elements used most frequently and stored together.

Punched Card

A card of standard size and shape in which data are stored in the form of punched holes. The hole locations are arranged in 80 or 90 columns with a given pattern of holes in a column representing one alphanumeric character. The data content is read by mechanical, electrical, or photoelectrical sensing of the hole positions. Often called a "Holerith" card.

Record

The basic unit of the bibliographic record file. It contains all data associated with an accession number entry.

Software

The programs used with a computer. These include library routines, assembly routines, utility routines, compilers, and applications programs. Contrasted to hardware.

Working Data

Data held in temporary storage and accessible from a single terminal. Minimal protection is provided for these data because they form what is essentially a staff member's "scratch pad."

APPENDIX G

REMOTE TERMINAL OPERATION

When a staff member wishes to consult a file, he depresses a sequence of alphanumeric keys, similar to the numeric keys on a pushbutton telephone and

- gets the machine's attention,
- gives it certain clues as to the data block of interest,
- defines the specific data elements desired from that block, and
- gives instructions on requisite manipulations

with considerably less expenditure of time and effort than if he were addressing a human file clerk. His answer appears almost immediately on the display screen. When he depresses another series of keys, a new display appears; the dialogue is then established.

Behind this deceptively simple interplay between the human and the machine is a highly complex but fully determinate set of logical functions, very little of which need be understood in more than an elementary fashion by the person using the system. An essential part of this terminal is the local memory. The staff member may key in the fact that he wishes to read some files, that he wishes to read in its entirety a specific record, that he wishes to read a specific data element or a predetermined set of data elements from that record. He does this by keying a series of short mnemonic codes and tags interspersed with English words. The display will show him what he has "said" to the machine. When he adds the command to execute, that display will disappear and be replaced promptly with the values of the desired data elements read from the requested record.

There are four distinct commands involved; the machine must be told:

1. What to do—read, write, or erase.
2. Where to do it—what file to access.
3. How to do it—the value of the entry point into the record.
4. What to bring back—the identity of the format that lists the requisite output elements.

The first command will always indicate the general function to be performed, of which there are only three types: read, write, and erase. A change is simply an erasure followed by a write. Many terminals will be restricted to a read-only function in order to provide an additional degree of protection to the permanent data base; therefore, a simplification is already possible because command is implicit from these terminals and need not be keyed in. Although these terminals do not have the ability to erase data in the general records, they do have a local erase capability. Thus, if a staff member keys in a request and discovers an error in the display, he can change (erase-write) the content of the request prior to its execution by the machine. When required, a simple mnemonic code is used to identify which of the three functions is to be performed.

The second command is also identified by a simple mnemonic code that identifies the file to be searched. The third command is identified by the data element tag followed by its value (i. e., the tag for a personal author, followed by his name, etc.). The fourth is again a mnemonic code that identifies a "form" to be filled out from the retrieved record. Thus, the display need not include the entire record but only those elements that are of interest to the specific user.

Because it is possible to erase data held in the input buffer, the mechanics of accomplishing this should be explored. Depressing the backspace key will erase the last character keyed in before that key was struck; repetitive striking of this key will erase successive characters in the reverse of the order in which they were keyed. "Erase" (depressing the backspace key) followed immediately by "line" and "line number" will cause deletion of that line and will permit the next entry (after a carriage return) to be inserted in its place. "Erase" followed immediately by "all" will cause deletion of the entire contents of the buffer and will reset the logic to its initial state.

Once the execute command has been given and once the data disappears and is replaced by the formatted retrieval record, certain changes in erasure logic are mandatory. The displayed data is being held in the local buffer as before, but it is now a copy of data in the data base, rather than the unique property of the terminal user. Changing the contents of the register does not, and should not, change the permanent record; however, the mechanics of effecting erasures are identical. Therefore, it is the associated logic and the eventual disposition of the changes that differ. There is no longer the requirement to sequence through a sequence of function; thus, each carriage return enables a new command. These commands may be a random sequence of erases and writes. When the execute command is issued, these erasures and write-ins are transferred to a temporary storage location, which is then linked from the permanent record. Subsequent read inquiries will pick up this link and also the defined changes incorporated in the displayed data only. Periodically, the cognizant staff member will review the contents of this temporary record and will merge it with the permanent record.

Certain other capabilities will be exhibited by these terminals. When a formatted record exceeds the number of lines of which the display is capable, an appropriate symbol will be displayed at the end of the last line. A page-forward command will then bring in the next increment of the retrieved record. Should the user wish to return to a previously displayed portion of this overflow record, a page-backward command will redisplay the previous increment. This forward and backward paging feature will be found useful when browsing the NAL subject terms, which are stored alphabetically and/or hierarchically.

Another feature useful for browsing, whether in the thesaurus, in the catalog, or in one of the authority files, is that of the scratch-pad memory. Selected lines from any display may be selected for transfer to the scratch pad. The contents of this scratch pad may be retrieved in their entirety and displayed in the conventional way or may be displayed one by one on the last line of the display while a command is being structured. The forward and backward paging capability permits the content of this last line to be changed to any entry on the scratch pad. A transfer command will then permit it to be incorporated bodily within any specific portion of the command being structured. A subject term, once identified on the display, need not be keyed into a record being generated or a search being formulated, thereby avoiding a tedious task and bypassing a potential source of much error. In a similar manner, authors once identified in an item record may be used in searches and in record creation without the user becoming involved in duplicating the precise spelling of the name. This scratch-pad memory will also serve to store accession numbers in a variety of circumstances that might otherwise force repetitive keying.

It might be argued that this terminal sounds like a small computer; philosophically, it is. Its memory is small, however, since it will hold little more than the number of characters of which the display is capable in a single presentation. The logic, for the most part, is simple and fully determinate; therefore, it may be hand-wired. Its input/output capability is limited and nonconcurrent. As a result, its cost is modest; it is available from a variety of manufacturers as essentially a standard item. Utilization of the full capability of this device, as described in this section, is dependent upon the development of the appropriate executive and input/output routines described in Chapter IV.